KLONDIKE NORTH FORK
HYDROELECTRIC GENERATION REDEVELOPMENT
NEAR DAWSON, Y.T.

Preliminary Study

KLONDIKE NORTH FORK
HYDROELECTRIC GENERATION REDEVELOPMENT
NEAR DAWSON, Y.T.

Preliminary Study

Prepared for:

Yukon Electrical Company Limited

Prepared by:

Yukon Electrical Company Limited
and
Acres Consulting Services Limited

With a contribution from:

Remote Community Demonstration Program
of Energy, Mines and Resources Canada

January 1985

RCDP/PDCE-53

This report was prepared with a contribution from the Remote Community Demonstration Program of Energy, Mines and Resources Canada (EMR). Distribution of this report by EMR does not necessarily signify that the contents reflect the views and policies of EMR. Mention of trade names and commercial products does not constitute recommendation or endorsement for use.

CONTENTS

Page

Abstract ix
Executive Summary xi
Résumé xv

1.0 INTRODUCTION 1
    1.1 History of Project 2
    1.2 Previous Studies 3
    1.3 Reference Data 4

2.0 SITE CONDITIONS 5
    2.1 Site Inspection 5
        2.1.1 South Fork Canal Intake 5
        2.1.2 South Fork Canal 5
        2.1.3 Kerr Creek Spillway 6
        2.1.4 Lee Creek Spillway and Diversion Dam 6
        2.1.5 Shovel Creek Spillway 7
        2.1.6 North Fork Point Spillway 7
        2.1.7 North Fork Diversion Dam 7
        2.1.8 North Fork Spillway 7
        2.1.9 North Fork Canal Intake 8
        2.1.10 North Fork Canal 9
        2.1.11 North Fork Canal Spillway 9
        2.1.12 Power Intake (Pressure Box) 9
        2.1.13 Penstocks 10
        2.1.14 Powerhouse 10
        2.1.15 Tailrace Weir 11
    2.2 General Observations 11
    2.3 Subsurface Conditions 12
    2.4 Mapping 13

3.0 LOAD FORECAST 14

4.0 HYDROLOGY 16
    4.1 Water Supply 16
    4.2 Simulation Studies 17
    4.3 Flood Hydrology 19

5.0 TRANSMISSION REQUIREMENTS 21

Page

6.0 NORTH FORK DEVELOPMENT 22
  6.1 Description of the Proposed Structure 23
    6.1.1 North Fork Diversion Dam 23
    6.1.2 North Fork Diversion Spillway 24
    6.1.3 North Fork Intake 26
    6.1.4 North Fork Canal 27
    6.1.5 Dempster Highway Crossing 29
    6.1.6 North Fork Canal Spillway 29
    6.1.7 Power Intake 30
    6.1.8 Penstock 31
    6.1.9 Powerhouse 32
    6.1.10 Powerplant 33
    6.1.11 Tailrace Weir and Channel 34
  6.2 Construction Materials 34

7.0 NORTH AND SOUTH FORK DEVELOPMENT 35
  7.1 Description of the Structures 35
    7.1.1 South Fork Diversion Weir 35
    7.1.2 South Fork Intake 36
    7.1.3 South Fork Canal 37
    7.1.4 Lee Creek Diversion Dam and Spillway 38
  7.2 Construction Materials 38

8.0 CAPITAL COST ESTIMATE AND SCHEDULE 39
  8.1 Basis of the Estimate 39
  8.2 Construction Schedule 40

9.0 ECONOMIC ANALYSIS 48
  9.1 Methodology and Assumptions 48
    9.1.1 Energy Balance 48
    9.1.2 Development Stages 48
    9.1.3 Method of Analysis 49
  9.2 Results 51
    9.2.1 Fuel Savings 51
    9.2.2 Economic Performance 51
  9.3 Discussion 54
    9.3.1 The Role of Electricity in Overall Energy Supply 54

10.0 CONCLUSIONS AND RECOMMENDATIONS 56

APPENDICES

Appendix A - Scope of Work 94
Appendix B - Economic Analyses 98
Appendix C - Flow-Duration Curves 151
Appendix D - Reference Data 166

LIST OF TABLES

Page

3.1 Base Year Electricity Demand at Dawson 15

4.1 Available Generation Summary 18

4.2 Peak Annual Discharges Klondike River Basin 19

4.3 Design Floor Discharges 20

8.1 North Fork Development Capital Cost Estimate - 2000 kW Installation 43

8.2 North and South Fork Development Capital Cost Estimate - 2000 kW Installation 44

8.3 North Fork Development Capital Cost Estimate - 2000 kW Installation 45

8.4 Estimated Capital Cost Elements of the South Fork Development 46

8.5 Transmission line Capital Cost Estimate - All Developments 47

9.1 Diesel Fuel Replacement by Hydroelectric Generation 52

9.2 Summary of Economic Results 53

9.3 Energy Balance for the Base Year 55

LIST OF FIGURES

		Page
1	Location Plan	59
2	Key Plan	60
3	Base Year Electricity Demand at Dawson	61
4	Duration Curve of Power Output for Year	62
5	Duration Curve for Power Output for January	63
6	Duration Curve for Power Output for February	64
7	Duration Curve for Power Output for March	65
8	Duration Curve for Power Output for April	66
9	Duration Curve for Power Output for May	67
10	Duration Curve for Power Output for June-September	68
11	Duration Curve for Power Output for October	69
12	Duration Curve for Power Output for November	70
13	Duration Curve for Power Output for December	71
14	Energy Supply and Demand Curves for January 1985	72
15	Energy Supply and Demand Curves for January 1995	73
16	Energy Supply and Demand Curves for January 2010	74
17	Regional Flood Frequency for Klondike River Basin	75
18	North Fork Diversion Dam	76
19	North Fork Canal Intake and Spillway	77
20	North Fork Spillway	78
21	Canal Rehabilitation and Check Weir	79
22	Canal Profile	80
23	North Fork Canal Spillway	81

LIST OF FIGURES
(Cont.)

		Page
24	Power Intake	82
25	Penstock	83
26	Powerhouse	84
27	Powerhouse Layout and Tailrace Weir	88
28	South Fork Diversion Weir	89
29	South Fork Canal Intake	90
30	Lee Creek Diversion Dam and Spillway	91
31	Project Implementation Schedule North Fork Development	92
32	Project Implementation Schedule North and South Fork Development	93
C.1	Duration Curve of Available Discharge for Year	153
C.2	Duration Curve of Available Discharge for January	154
C.3	Duration Curve of Available Discharge for February	155
C.4	Duration Curve of Available Discharge for March	156
C.5	Duration Curve of Available Discharge for April	157
C.6	Duration Curve of Available Discharge for May	158
C.7	Duration Curve of Available Discharge for June	159
C.8	Duration Curve of Available Discharge for July	160
C.9	Duration Curve of Available Discharge for August	161
C.10	Duration Curve of Available Discharge for September	162
C.11	Duration Curve of Available Discharge for October	163
C.12	Duration Curve of Available Discharge for November	164
C.13	Duration Curve of Available Discharge for December	165

ACKNOWLEDGEMENTS

The Remote Community Demonstration Program is adminstered under the Authority of the Minister of Energy, Mines and Resources Canada. The Yukon Electrical Company Limited wishes to acknowledge the financial assistance provided under the Program in support of this study and the technical input to the study by Acres Consulting Services Limited. The Company also appreciates the participation, input and information provided by the Northern Canada Power Commission as their contribution to the study.

The Yukon Electrical Company Limited also wishes to acknowledge and express thanks for the participation of many other agencies and individuals, including the Public Archives of Canada, Public Archives of Yukon, Parks Canada personnel in the City of Dawson (Dawson City), Yukon, Mr. Newton Webster City of Dawson, Yukon, Monenco Consultants and Teck Corporation.

ABSTRACT

The Klondike North Fork hydroelectric plant, located 35 km east of Dawson City, Yukon Territory, operated from 1911 to 1967 at outputs of up to 10 000 kW. The peak electrical demand at Dawson now is approximately 1500 kW. This study evaluates how the site might be redeveloped to provide electricity to Dawson and assesses the prospects for displacing oil and related cost savings.

The study concludes that installation of either 1000 kW or 2000 kW developments would be economic and could result in displacement of approximately 2 million litres per year of diesel fuel. Additional capacity could be added in the future in response to future load increases.

Environmental, socio-economic, land rights, and jurisdictional issues have not been addressed in this study.

EXECUTIVE SUMMARY

A preliminary study of the feasibility of generating electric power for the community of Dawson, Yukon Territory by redeveloping the Klondike North Fork generating station has been carried out. Partial funding for the study was provided by the Government of Canada as part of the Remote Community Demonstration Program which seeks to demonstrate oil reduction or displacement technologies which will improve the quality, price or security of energy supplies in remote Canadian communities.

The objective of the study was to establish whether, under present day conditions, there might be an opportunity for cost savings in electricity supply by redeveloping part of the Klondike North Fork hydroelectric project.

Environmental, socioeconomic, land rights and regulatory issues would influence redevelopment of the project. These were set aside at this preliminary stage in order to quickly establish whether any sort of redevelopment might be attractive and what general form a feasible redevelopment might take.

The Klondike North Fork power project was developed in 1910 and 1911 and eventually was expanded to a 10 500 kW capacity. The project included a power station with a gross operating head of approximately 69.5 m. Water was supplied by a 4.6 km long canal from a diversion point on the North Klondike river and by a second canal extending a further 26 km to a diversion point on the Klondike River. The electric power which was generated was primarily used by the large dredges which mined the gold bearing gravels in the Klondike River valley. Power was also supplied to Dawson. Under winter conditions, the capacity of the powerplant was reduced to an average of 2500 kW due to the lower river flows available. That reduced output was sufficient to meet the electricity needs of the community including a significant energy consumption for water heating. At the beginning of winter, extreme efforts by large maintenance crews were needed to prevent ice from blocking the canals and causing a complete interruption of power supply. The power plant operated until 1967. Since then, Dawson has been supplied with electrical power from a diesel generating station in the town. Heating of the water supply and some space heating has been achieved using waste heat from the diesel engines.

Redevelopment of the project would involve replacement of the intakes, key spillways, and the penstocks. Minor spillways which were previously used to divert slush ice would be abandoned. The canals would be cleared of vegetation

and minor bank repairs effected. Fourteen check weirs would be added to the canals to reduce water velocities. With suitably low flow velocities in the canals, an ice cover would develop easily at the beginning of winter ensuring reliable water conveyance to the turbines throughout the winter months.

The North Fork Diversion Dam would be rehabilitated and a new spillway and intake structure provided. A new weir would be required to divert water into a new South Fork Intake. Provision has been allowed in the cost estimates for the cost of providing a passage for fish past each of these diversion structures.

For the purpose of the study, it has been assumed that one or two new 1000 kW turbine-generator sets would be installed in part of the existing powerhouse. A new transmission line would be built to Dawson making use of some existing poles and right-of-way.

Three development scenarios were considered. The first two would use flows from the North Klondike River only and would not require construction of the costly South Fork diversion structure or rehabilitation of the South Fork canal and structures. Installed capacities of 1000 and 2000 kW were considered. This has been named the 'North Fork Development'. The third would include the South Fork installations and would exploit the combined flows from the Klondike River and its tributary, the North Klondike River. This has been named the 'North and South Fork Development'. The production of electricity and estimated capital costs for each alternative is summarized in the following table.

ENERGY GENERATION AND ESTIMATED COST OF ALTERNATIVE DEVELOPMENTS

Development	Installed Capacity (kW)	Average Output (kW)	Minimum Output (kW)	Proportion of Time Full Capacity Available (%)	Estimated Capital Cost ($ million)
North Fork	1000	989	623	92.6	5.1
North Fork	2000	1685	623	57.2	6.0
North and South Fork	2000	1999	1916	99.6	9.6

The economics of redevelopment have been assessed in terms of the value of fuel costs which could be displaced at the diesel generating station in Dawson. Peak electrical generation in 1984 varied through the year from 1147 to 1436 kW and the total energy requirement for the year amounted to 8234 MW.h, equivalent to an average output of 940 kW. A base case of future electricity requirements has been estimated using 1.6 percent per year growth based on forecasts by the Northern Canada Power Commission.

The fuel savings have been assessed on a month-by-month basis by matching the average generating capability of the hydroelectric plant with the forecast demands over a 30 year period. The energy needs of water heating have been accounted for using electricity, oil fired heating or waste heat from diesel generation as most appropriate. Predicted net fuel savings are as follows:

PREDICTED FUEL SAVINGS - litres per year

Development	Annual Fuel Saving - Millions of Litres	
	Fuel Savings First Year	Fuel Savings 30th Year
North Fork 1000 kW	1.9	1.9
North Fork 2000 kW	2.4	3.2
North and South Fork 2000 kW	2.5	3.7

ECONOMIC ANALYSIS

Economic analyses were carried out to compare the costs of meeting the projected electricity and heating requirements with and without the hydroelectric redevelopment. The following table summarizes the base case results:

Development	Base Case 1984 Net Present Value of Savings ($ millions)
North Fork 1000 kW	3.2
North Fork 2000 kW	5.9
North and South Fork 2000 kW	3.3

- Present value of diesel fuel savings less hydro costs over 30 years calculated with a discount rate of 13 percent per year.

- General inflation rate of 5 percent per year.

- Load growth at a rate of 1.6 percent per year.

Various rates of load growth, rates of escalation of fuel prices and discount rates were considered in sensitivity analyses. A net saving was predicted for all redevelopment alternatives for all conditions tested. The study has not, however, addressed the impact of the development on the electricity rates.

It is concluded that redevelopment of a hydroelectric station using parts of the old Klondike North Fork development offers an opportunity to realize significant savings in future electricity costs.

It is recommended that a preliminary study be undertaken to address environmental, socioeconomic, land rights and regulatory issues. If the results of that preliminary study prove to be favorable, it is recommended that a feasibility study be undertaken to:

(a) obtain more complete field data, and develop designs in more detail so that:

  - the most attractive staging of the redevelopment can be decided
  - the development plan accommodates environmental and other requirements
  - the cost estimates can be established at a level of certainty to support investment decisions;

(b) set out a phased plan of development which will maximize the expected savings by providing for flexible expansion of the hydroelectric capabilities in response to future increases in electricity demand or fuel prices.

This report refers to the North Fork and South Fork of the Klondike River. The official names of these rivers are now, respectively, North Klondike River and Little South Klondike River.

RÉAMÉNAGEMENT DE LA CENTRALE HYDRO-ÉLECTRIQUE KLONDIKE NORTH FORK

PRÈS DE DAWSON (YUKON)

Étude Préliminaire

Résumé

Cette étude préliminaire porte sur la faisabilité d'alimenter en électricité la collectivité de Dawson au Yukon en réaménageant la centrale Klondike North Fork. Énergie, Mines et Ressources Canada a financé une partie de cette étude dans le cadre de son Programme de démonstration dans les collectivités éloignées, programme qui vise à faire les études et la démonstration des techniques de réduction ou de remplacement du pétrole qui sont susceptibles d'améliorer la qualité, le prix ou la sécurité en matière d'alimentation en énergie dans les collectivités éloignées du Canada.

Cette étude a pour objectif d'établir si, dans les conditions actuelles, il existe une possibilité de réaliser des économies en matière d'électricité en réaménageant une partie de la centrale hydro-électrique Klondike North Fork.

Bien que les questions relatives à l'environnement, au milieu socio-économique, aux droits fonciers et à la réglementation auraient des répercussions sur le réaménagement de cette centrale, elles n'ont pas été prises en considération au stade préliminaire puisqu'il s'agissait d'abord de savoir s'il allait être intéressant de procéder à tout type de réaménagement et quelle forme de réaménagement en général pouvait être réalisable.

Construite en 1910-1911, la centrale Klondike North Fork a été par la suite agrandie pour atteindre une puissance de 10 500 kW. Elle comportait une usine hydro-électrique dotée d'une hauteur de chute brute d'environ 69,5 m. Un canal de dérivation de 4,6 km branché sur la rivière North Klondike et un second canal de dérivation de 26 km sur la rivière Klondike alimentaient l'usine en eau. La production d'énergie

---

Note: Ce rapport fait mention des embranchements nord et sud de la rivière Klondike. Ces rivières sont maintenant connues officiellement comme étant respectivement la rivière North Klondike et la rivière Little South Klondike.

hydro-électrique servait principalement à alimenter les grandes installations de dragage utilisées pour exploiter les graviers aurifères de la vallée de la rivière Klondike. Elle servait également à alimenter la ville de Dawson. En hiver, par suite de la diminution du débit des rivières, la capacité de la centrale diminuait pour atteindre une moyenne de 2 500 kW. Malgré cette baisse, la production d'énergie était suffisante pour approvisionner l'agglomération, dont les besoins incluaient le chauffage à l'eau chaude. Au début de l'hiver, de grandes équipes d'entretien devaient travailler ferme pour empêcher la glace de bloquer les canaux et de causer l'interruption de la centrale. Celle-ci a été exploitée jusqu'en 1967. Depuis cette date, la ville de Dawson se sert d'une centrale au diesel située dans la ville même. Le chauffage de l'eau ainsi que de certains locaux a été assuré par l'utilisation de la chaleur perdue de génératrices diesel.

Le réaménagement de la centrale impliquerait le remplacement des prises d'eau, des évacuateurs de crue principaux et des conduites forcées. Les petits évacuateurs de crue utilisées antérieurement pour détourner la gadoue ne serviraient plus. Les canaux seraient débarassés de la végétation qui s'y est installée et les rives feraient l'objet de réparations mineures. Quatorze déversoirs de retenue seraient ajoutés dans les canaux de façon à réduire leur débit et à favoriser la formation d'une couverture de glace au début de l'hiver, assurant ainsi le transport de l'eau vers les turbines tout le reste de l'hiver.

Il faudrait remettre en état le barrage de dérivation North Fork et construire un nouvel évacuateur de crue et une installation d'alimentation. Il faudrait aussi construire un nouveau déversoir pour détourner l'eau vers une nouvelle prise d'eau sur South Fork. Il est prévu dans l'estimation des coûts d'allouer un certain montant à la construction d'une passe à poissons après chacune de ces structures de dérivation.

Aux fins de cette étude, un ou deux nouveaux turbo-générateurs de 1 000 kW seraient installés dans l'usine existante. Il faudrait installer une nouvelle ligne de transport d'électricité jusqu'à Dawson en utilisant certains poteaux et l'emprise existants.

Trois scénarios d'aménagement ont été analysés. Les deux premiers consisteraient à n'utiliser que le débit de la rivière North Klondike, évitant ainsi la construction coûteuse de l'ouvrage de dérivation South Fork ou le réaménagement du canal et des ouvrages sur South Fork. Les puissances installées de 1 000 et 2 000 kW ont été évaluées séparément. Ces deux scénarios sont appelés "Aménagement de la North Fork". Le troisième scénario inclurait les installations de South Fork et utiliserait les débits combinés de la rivière Klondike et de son affluent, la rivière North Klondike. Ce scénario est appelé "Aménagement de la North Fork et de la South Fork". La production d'électricité et les coûts en capital prévus relativement à chacun de ces scénarios sont résumés au tableau suivant.

PRODUCTION D'ÉNERGIE ET COÛTS ESTIMATIFS RELATIFS À CHACUN DES AMÉNAGEMENTS

Aménagement	Puissance installée (kW)	Production moyenne (kW)	Production minimale (kW)	% de temps où la pleine puissance est disponible (%)	Coût en capital prévu (millions de dollars)
North Fork	1 000	989	623	92,6	5,1
North Fork	2 000	1 685	623	57,2	6,0
North Fork et South Fork	2 000	1 999	1 916	99,6	9,6

L'aspect économique du réaménagement a été évalué en fonction de la valeur monétaire du combustible qui est utilisé à la centrale au diesel de Dawson et qui pourrait être remplacé. Au cours de l'année 1984, la production maximale d'électricité a varié entre 1 147 et 1 436 kW et les besoins totaux se sont élevés à 8 234 MW/h, équivalant à une production moyenne de 940 kW. Les besoins futurs en électricité devraient augmenter de 1,6 % par année si l'on se fonde sur les prévisions de la Commission d'énergie du Nord canadien.

Les économies de combustible ont été calculées sur une base mensuelle en faisant correspondre la capacité de production moyenne de la centrale hydro-électrique avec les besoins prévus sur une période de 30 ans. L'énergie nécessaire aux chauffe-eau a été attribuée à la production d'électricité, aux appareils de chauffage au mazout ou à la chaleur perdue des groupes diesel, selon ce qui semblait le plus approprié. Les économies nettes de combustible prévues sont les suivantes:

ÉCONOMIES PRÉVUES EN MATIÈRE DE COMBUSTIBLE - en litres par année

Aménagement	Économies annuelles en combustible - en millions de litres	
	Économies en combustible Première année	Économies de combustible 30e année
North Fork (1 000 kW)	1,9	1,9
North Fork (2 000 kW)	2,4	3,2
North Fork et South Fork	2,5	3,7

ANALYSE ÉCONOMIQUE

Des analyses économiques ont été effectuées pour comparer ce qu'il en coûterait pour satisfaire aux besoins prévus en électricité et en chauffage si la centrale fait l'objet d'un réaménagement et dans le cas contraire. Le tableau suivant fournit un résumé des résultats:

Aménagement	Cas type Valeur actuelle nette des économies en 1984 (millions de dollars)
North Fork (1 000 kW)	3,2
North Fork (2 000 kW)	5,9
North Fork et South Fork (2 000 kW)	3,3

- La valeur actuelle des économies de combustible diesel moins les coûts de l'hydro-électricité sur 30 ans sont calculées en fonction d'un taux d'actualisation de 13% par année.
- Le taux d'inflation général est de 5% par année.
- L'accroissement de la demande est de 1,6% par année.

Les divers taux de croissance de la demande, les taux d'augmentation des prix des combustibles et les taux d'actualisation ont été pris en compte dans les analyses de sensibilité. Il est ressorti de ces analyses qu'une économie nette serait réalisée dans chacun des projets de réaménagement dans toutes les conditions évaluées. Cette étude, cependant, n'a pas traité des effets qu'entraîneraient les aménagements sur les coûts de l'électricité.

En conclusion, il appert que le réaménagement d'une centrale hydro-électrique qui utiliserait les installations de l'ancienne centrale Klondike North Fork permettrait de réaliser des économies importantes relativement aux coûts futurs d'électricité.

Il est recommandé qu'une étude préliminaire soit entreprise pour traiter des questions relatives à l'environnement, au milieu socio-économique, aux droits fonciers et à la réglementation. Si les résultats de cette étude préliminaire s'avèrent favorables, il est recommandé qu'une étude de faisabilité soit effectuée pour:

a) obtenir des données de terrain plus exhaustives et mettre au point des concepts plus détaillés pour que:
   - le réaménagement soit élaboré selon le plan par étapes le plus intéressant;
   - le plan d'aménagement satisfasse aux exigences environnementales et autres;
   - les estimations relatives aux coûts soient établies avec le degré de certitude nécessaire pour encourager les investissements;

b) élaborer un plan par étapes d'aménagement qui permette de réaliser les économies maximales projetées, en prenant les dispositions nécessaires pour que la puissance de la centrale puisse être accrue éventuellement pour faire face à l'accroissement des besoins en électricité ou du prix des combustibles.

1 - INTRODUCTION

The Klondike North Fork hydroelectric power site, which is located 35 km to the east of Dawson as shown on Figures 1 and 2, was developed during the 1910 to 1935 period, mainly for seasonal operation to supply power to the dredges mining for gold in the Klondike River valley. A total generating capacity of approximately 10 000 kW was ultimately installed. Operation of the power project was discontinued in 1967 and the powerplant installations were dismantled.

A number of studies of the viability of generation at this site to supply the smaller demand of the community of Dawson and surrounding area were carried out, both before operations were discontinued in 1967 and since the advent of sharply increased fuel oil prices. The results of these studies are not adequate, however, to establish whether redevelopment of the site for generation in the mid 1980's would be economically attractive.

The present study was commissioned to review only the technical and economic aspects of redevelopment at the site. Possible environmental, socio-economic, land rights, and regulatory issues have not been addressed. A specific plan of development and water use has been prepared at a prefeasibility level on the understanding that if an economic and practical project is indicated, then subsequent studies will consider the broader implications of the project.

This study has been carried out with financial assistance from the Government of Canada represented by the Minister of Energy, Mines and Resources as part of Canada's Remote Community Demonstration Program.

The study was managed by the Yukon Electrical Company Limited (YECL). Acres Consulting Services Limited (ACRES) was retained to appraise the existing structures and develop preliminary designs and cost estimates for redevelopment. YECL developed a forecast of load growth with assistance from the Northern Canada Power Commission (NCPC) and carried out the economic analyses.

The scope of work for the study, which was agreed to by Energy, Mines and Resources Canada, is included as Appendix A.

1.1 History of the Project

The Klondike North Fork hydroelectric power development was constructed and commissioned by the Granville Power Company in 1910-1911 to supply electric power to the extensive dredging operations that recovered gold from the Klondike River sediments. The original development diverted water from the North Klondike River and carried it along a 9.5 km long, 14 m^3/s capacity canal and through two steel penstocks to develop a gross head of 69.5 m at the powerplant located in the Klondike River valley. Initially, two turbines were installed with a total capacity of 10 000 hp and a total generator capacity of 5 400 kW.

During 1915-1916, construction of a second power development in the upper reaches of the North Klondike River was started. This was known as the Mischenko Project. The scheme was subsequently abandoned because the available storage of 197 000 m^3 was too small and because of water rights conflicts.

In 1935, after the Yukon Consolidated Gold Corporation (YCGC) was formed, a second canal 26 km long with a capacity of 7 m^3/s was completed to carry water from the Klondike River to the intake of the North Fork Canal. The capacity of the North Fork Canal was increased to 21 m^3/s by dredging and the powerplant installation was increased by the addition of a third unit. The ultimate installed capacity was 15 000 hp with the three generators rated at a total of 10 500 kW.

The development was a run-of-the-river plant with no storage other than canal capacity, and with substantially reduced available flows in the winter. However, since the principal purpose of the powerplant was to provide power to the gold dredging operations, which also closed down during the winter months, the small amount of firm power available was not a problem. Power was generated during the winter to supply light and heat to the YCGC maintenance shops, and staff houses, and also to supply electricity to Dawson. In Dawson, heavy reliance was placed on electricity to provide the necessary heat to maintain domestic water and sewer service in winter.

Every year during freeze-up, major problems with frazil ice and ice jamming in the canals was experienced until a stable ice cover was formed over the canals. A large crew of men was employed during this period to sluice away the slush and cake ice through the various spillways along the canal and to break up the hanging ice dams that formed. During this period, an ice dam was built across the Klondike River by blasting river ice, enabling most of the available river flow to be diverted into the South Fork canal. After the ice cover was in place, the powerplant output was limited by the inflow from both the North Klondike River and the Klondike River and by any anchor ice that partially blocked the canal.

The winter output of approximately 2500 kW generally met the winter power demand. During the freeze-up period, when the output often dropped to as low as 200 kW, power supply interruptions and poor voltage and frequency regulation occurred. The company maintained a small diesel generator in Dawson to make up the deficiency.

The powerplant was closed down in 1967 when YCGC terminated their gold dredging operations. At that time, the Northern Canada Power Commission (NCPC) took over the electrical distribution system but declined to take over the power generation facilities. It was found to be more economical to meet the electricity needs of the Dawson area by diesel generation. The peak load at that time was less than 1000 kW. The various project structures have since deteriorated and have been subjected to scavenging.

The powerhouse was purchased by a local outfitter who sold the turbines and generators and now uses the building as a shelter for equipment and supplies and as a hanger for his aircraft. If a redevelopment is undertaken, any use of the existing facilities or any property where the old works were located would depend on establishing a development plan which properly protects the interests of the present property owners.

1.2 Previous Studies

The first and most comprehensive study of the project with respect to its use as a dedicated source of power for Dawson was carried out by the Montreal Engineering Company Limited (MECo) for NCPC during 1961. YCGC had previously announced its intention to close down the gold mining operation in the fall of 1965. The MECo study covered all utilities owned by

YCGC. The existing facilities were inspected and the cost of rehabilitating and modifying them was estimated with respect to the use of the project as a economic source of power for Dawson.

The project was again studied and cost estimates were prepared by NCPC in 1966. This study was reviewed by Monenco Consultants Pacific Ltd. (Monenco), an associate company of MECo. Both organizations viewed the prospect of reactivating the project negatively and no further action is known to have taken place.

1.3 Reference Data

In the course of preparing the present study, reference data were collected from various sources. These are listed in Appendix D.

2 - SITE CONDITIONS

2.1 Site Inspection

The project site was inspected by engineers from YECL and ACRES on August 28, 1984. The party was accompanied by Mr. F. Dorward from NCPC and Mr. N. Webster who worked for YCGC as a plant operator from 1935 to 1967. Mr. Webster, the chief powerplant operator at the time of its shutdown in 1967, was able to contribute useful background knowledge about the project.

It had snowed the previous day and most of the facilities were covered with a layer of snow which limited the inspection somewhat. The full length of the canals was viewed. Vehicle access was only possible to the washout near Kerr Creek, the remainder of the inspection was carried out on foot. All structures were inspected to the extent possible and their present condition noted. The following paragraphs summarize the findings. The locations of the described structures are shown on Figure 2.

2.1.1 South Fork Canal Intake

The intake is a timber structure with a timber gatehouse on top. There is a bridge with timber decking on the downstream side which is in poor condition. The intake is located on the right bank about 20 m from the edge of the river. There are no diversion works across the Klondike River. Water enters the intake through an excavated channel approximately 8 m wide. The right bank of the intake channel is supported at its upstream end by steel sheet piles which forms a transition to a vertical timber retaining wall adjacent to the intake. The channel is completely blocked with debris. There are six openings 1.1 m wide by 2.1 m high. Each is equipped with an unreinforced sheet steel bulkhead gate 1.2 m wide by 2.4 m high manually operated by means of a 76 mm diameter screw stem hoist. The water upstream of the gates was heated in the winter by means of electric coil heaters located just upstream of the gates.

2.1.2 South Fork Canal

Significant erosion of the left canal bank has occurred approximately 1.5 km downstream from the South Fork Intake. At this location, the Klondike River has broken into the canal, presumably during flood, depositing a gravel bar along this reach of the canal.

The canal has broken its banks approximately 1 km to the west of Kerr Creek, discharging the Kerr Creek and other upstream flows through an approximately 2 m wide eroded channel downslope into the Klondike River. This washout was not passable by vehicle and required the canal and project facilities to the east to be inspected on foot.

In general, the canal is in good shape. With the exception of 17 years of vegetation growth that would need to be cleared, a minor amount of canal bank stabilization, and the repairs to the two broken banks, it is essentially in operating condition. The left bank access road would need grading and resurfacing before it could be used for construction access.

2.1.3 Kerr Creek Spillway

This timber spillway has four 86 cm clear openings with a height of 2.5 m which were closed off with flashboards. The South Fork Canal access road has been constructed on the downstream side of the spillway effectively damming it. The timber deck spans are still in evidence. The spillway timbers are in reasonably good shape considering that the structure is reputed to have been built in the early days of the project. Mr. N. Webster stated that, to his knowledge, the spillway was never used.

2.1.4 Lee Creek Spillway and Diversion Dam

This was the largest spillway along the South Fork Canal and comprises an operating section and an emergency section separated by the Lee Creek Diversion Dam. The diversion dam is formed by an earth embankment with an intermediate section of earthfill supported between vertical timbers. The timber spans of the bridge across the operating spillway remain but the decking is missing. It was necessary to ford Lee Creek during the inspection. During operation, the 9.6 m spillway opening was closed with flashboards supported between seven timber posts hinged at the sill and braced from the downstream side. The steel mounts for the support posts could still be seen in the riverbed. Lee Creek is currently discharging all of its flow through the spillway as the canal entrance on the right bank has been blocked with earthfill. The emergency spillway which was located to the right of the operating spillway has been backfilled with road fill and little evidence of its presence was found. The timber spillway (flume) could not be seen.

2.1.5 Shovel Creek Spillway

This spillway was a timber structure of which there is little remaining. Road fill has been placed across the structure, presumably after the timber bridge deck collapsed. The timber supports for the flashboards are still present.

2.1.6 North Fork Point Spillway

This is a timber structure with four openings each approximately 1 m wide with a height of 3 m above the earth floor. The structure is topped with a timber deck which presumably was used to carry traffic. It has since been abandoned and the South Fork Canal access road has been diverted around the upstream end of the spillway effectively cutting off the entrance and flashboards. Downstream of the spillway are the remnants of the timber flume that carried the discharge downslope. There is no sign of the flashboards used to control the outflow.

2.1.7 North Fork Diversion Dam

Water was diverted from the North Klondike River into the North Fork Canal by a low earthfill dam located along the east-west reach of the river just upstream of the North Fork Spillway as shown on Figure 2. The embankment is 2.5 m high at its highest point. The South Fork Canal access road passes along the top of the dam. On the upstream side, the slopes are steeper than 1 vertical to 1 horizontal and are being actively eroded at the toe by the river. The downstream slopes are close to 1 vertical to 2 horizontal and are essentially stable and support some tree and vegetation growth. No significant leakage through the dam was observed on the downstream side. The road along the crest of the dam is in good condition. It was not possible to determine whether the dam crest, which appears to be horizontal, provides adequate freeboard.

2.1.8 North Fork Spillway

The spillway originally consisted of a double timber apron 32 m wide and approximately 11.3 m long, supported on a timber grid. The floor of the spillway and the river was subsequently protected with a perforated steel plate which was not visible during the inspection. The level of flow through the intake and the canal was regulated by means of flashboards spanning 1.5 m between removable, vertical timber braces socketted into steel angles set in the spillway apron.

The flashboards were inserted and removed by hand. Control of upstream water levels to a maximum height of 1.5 m above riverbed was possible by these means. None of the timbers of the apron were visible. However, the river dropped 30 cm to 40 cm over a weir at the centre of the spillway indicating that part of the original timbers were still in place.

Downstream of the spillway is a bridge with two spans separated by a timber crib pier in the centre of the river. The pier is protected by steel plate and rails. The total clear spans of the bridge are approximately 25 m. The right span is a steel truss and timber structure and the left span is a Bailey-type structure. The bridge has been recently repaired and is apparently in good condition.

2.1.9 North Fork Canal Intake

The North Fork Canal Intake is a timber structure, with eight 1.22 m x 2.44 m steel vertical slide gates, each manually operated by a 76 mm diameter screw stem hoist. There are two emergency gates, one at each end of the intake structure. Neither are equipped with hoists. The gates consist of a single sheet of unreinforced steel, approximately 10 mm thick, which slide in simple guides bolted to the timber support of the intake. An insulated timber framed, galvanized steel clad gatehouse has been built above the intake. The floor of the intake is reported to have been protected from erosion by a perforated steel plate, although this was not observed during the inspection.

Immediately downstream of the intake are the remnants of a timber truss bridge that has collapsed into the canal.

The right bank of the approach channel is protected by steel sheet piling retaining walls for a distance of approximately 60 m upstream of the intake. On the left side of the intake, the access road along the canal bank is supported by steel sheet piles as it leads to the bridge across the North Fork Spillway. The area between the intake and bridge, enclosed by sheet piling, has been filled to the top of the piling to provide access to the intake gatehouse. Downstream of the spillway, the right bank and access road is supported by timbers between H piles.

2.1.10 North Fork Canal

The canal is blocked by earthfill just downstream from the North Fork Intake and also where the recently completed Dempster Highway crosses the canal. It is dry for most of its length and overgrown with willows and other vegetation. The canal banks are sloped at between 1 vertical and 1 horizontal to 1 vertical to 2 horizontal and are essentially stable.

2.1.11 North Fork Canal Spillway

This spillway was used to control the water level at the power intake end of the North Fork Canal and to bypass ice and debris. The spillway is constructed of timber and is equipped with three 1.2 m wide by 2.4 m high unreinforced sheet steel gates located at its downstream end. Each gate can be operated manually by a 76 mm diameter screw stem hoist. However, the water passages upstream of the gates are completely blocked with soil, endorsing reports that the gates have probably never been used. On each side of the gated spillway is a 1.2 m wide sluice equipped with flashboards. The bridge across the top of the spillway has collapsed and is impassable. The 76 m long timber flume that carried the spillway discharges down the hill to the Klondike River, has settled or was damaged by flood flows, and is in a poor state of repair.

2.1.12 Power Intake (Pressure Box)

The YCGC term for the power intakes was "Pressure Box". This Pressure Box is an 8 m by 14 m timber structure that housed the gates between the canal and the penstocks. It is enclosed by a timber gatehouse with a galvanized iron roof. Many of the timber supports and cladding have been removed by scavengers. There are three intakes, each leading to a penstock, separated by a timber wall with a concrete nosing. Each intake has a 1.2 m wide by 2.4 m high unreinforced sheet steel bulkhead gate operated manually by a 76 mm diameter screw stem hoist. The gates move between simple guides. In front of the gates are steeply inclined steel trash racks with 50 mm spacing between the vertical 63 mm by 9 mm steel bars.

2.1.13 Penstocks

Three buried penstocks, approximately 482 m long, connect the Pressure Box to the turbines. The penstocks are constructed of 7 mm rivetted rolled steel plate. Over most of their length the penstocks are 1.68 m diameter with a long tapered section to 2.44 m diameter at the Pressure Box end and a shorter tapered section to 1.22 m diameter at the turbine end. Each penstock was fitted with "a manhole, air valves, three expansion joints and three sets of anchors"(1). Inspection of Penstock No. 1 from the Pressure Box end revealed its structural condition to be very poor. The inner surface is severely rusted and is very uneven. The expansion joints at the middle of the penstock length were exposed. All penstocks have separated at the expansion joint by more than 50 mm. The upper and lower expansion joints and the vacuum relief valves are still buried and could not be inspected.

Bursting of the penstock was apparently a frequent occurrence and was attributed to strains caused by slope instability, although there was no surficial evidence of such instability other than shallow solifluction. There is no doubt that the penstocks are being subjected to forces tending to elongate the pipe as was evidenced at the expanison joint that was exposed. Penstock repairs were generally welded.

2.1.14 Powerhouse

The Powerhouse substructure comprises unreinforced concrete building foundation walls of gravity retaining wall construction with separate turbine foundations. These are connected at the top by the concrete powerhouse floor. The concrete foundation walls are cracked vertically and are bulging outwards suggesting settlement. The turbine blocks appeared to be in reasonable condition, with minor cracking showing on the surface.

The superstructure is a timber framed building clad with corrugated galvanized steel. The turbines, generators and most of the other equipment are no longer in the Powerhouse.

---

(1) MECo report, "Dawson City Utilities, Interim Report". October 1961.

It is currently used by its new owner to store hay and farm equipment. The north end has been converted into an aircraft hanger by installing large doors on the upstream face and building a timber floor above the old concrete floor.

During the inspection below powerhouse floor level, it was noted that two of the pressure relief valves are still in place and appear to be in reasonably good condition. The travelling bridge hoist is also still in place and apparently in operating order.

2.1.15 Tailrace Weir

The timber crib tailrace weir is heavily overgrown and rotting. The tailrace pond and channel to the Klondike River are full of vegetation and willows.

2.2 General Observations

Considering that 17 years have elapsed since the powerplant was last in operation, and that some parts of the project are over 70 years old, the various facilities and structures are in remarkably good condition. However, none of the timber structures can be recommended for rehabilitation. The cost of attempting to salvage some parts and replace others would be greater than constructing entirely new concrete and steel structures. In addition, none of the hydraulic passages are sized for the smaller power flows proposed for the rehabilitation or for the corresponding flood flows. The gates and heaters are not compatible with modern design, and could not be adopted for remote control. Lastly, considering the economic life of the redevelopment, timber structures would be less durable and would require more maintenance than would concrete and steel structures.

Both canals and the various diversion dams could be restored with a minimum of cost or effort. The canals are wider than would be required for the lower power flows proposed, but this would not detract from efficient and trouble free operation. The access roads on the left and downslope bank of the canals have been recently upgraded and are regularly maintained to permit tourists off-highway access to the more remote parts of the Klondike River valley. Little would need to be done to these roads before they could be used for construction access and for the operating and maintenance staff.

The penstocks appear to be in an advanced stage of corrosion, based on an inspection of the interior surfaces. This is not surprising since two of them have been buried for more than 75 years and the third for around 50 years. In view of this, it has been assumed for this study that a new penstock would have to be provided. To verify this, future studies should include a detailed investigation using non-destructive testing techniques, substantiated by drilling and direct measurements of the unrusted steel thickness, to ascertain whether one of the penstocks might be in a sufficiently serviceable condition that it could again function satisfactorily.

The Powerhouse could be rehabilitated with a minimum of cost. The turbine and generator foundations are in a functional condition and would be very unlikely to settle or deflect under load. The building and travelling bridge hoist would need some renovation now and during the life of the redevelopment but are essentially functional. The amount of space available in the existing building would, however, be larger than needed for the redevelopped powerplant.

2.3 Subsurface Conditions

The subsurface conditions in the vicinity of the project site were observed superficially during the site inspection. At that time, there was a layer of snow partially covering the ground and there were no provisions made to drill or excavate below the surface except with a geological pick. This very limited information and knowledge of the general geology of the area, were, however, adequate to assess the existing structures and to prepare preliminary designs for cost estimating purposes.

The Klondike district near Dawson has not been subjected to glaciation. The surficial deposits along the canals are generally talus, and river terrace deposits, with bedrock close to the surface in the vicinity of the North Fork Intake. The project is located in the northern part of the discontinuous permafrost zone and permafrost was encountered frequently in the project area, particularly on the penstock slope, during the operation of the power development. The presence of permafrost and the seismicity of the area have been taken into account in the preliminary designs and construction plans. The project is within the less seismically active region of the Yukon Territory and falls within Seismic Zone 2 of the Seismic Zoning Map presented in the National Building Code of Canada. A seismic risk analysis was obtained from the Earth Physics Board, EMR. The results are as follows:

Probability of Exceedence	0.01	0.005	0.002	0.001
Peak Horizontal Acceleration (% g)	5.2	6.6	8.5	10.2
Peak Horizontal Velocity (m/s)	0.115	0.146	0.195	0.233

(g = acceleration due to gravity)

2.4 Mapping

The results of a field reconnaissance and survey of the canals carried out by NCPC in 1975 were particularly useful. During this reconnaissance, benchmarks were established, and cross sections of the canal were surveyed, at intervals of one mile along the canals. In addition, the invert elevation of the canals was taken at least every half mile. Additional canal sections were taken at the intakes. These data, together with information obtained from the YCGC drawings from Public Archives, Canada, were considered adequate to meet the design requirements of this present study and no further survey or mapping work was considered warranted.

3 - LOAD FORECAST

A forecast of electricity requirements at Dawson was made by establishing the loads for a base year and applying estimated rates of growth corresponding to various assumptions.

The base year was derived from generation data for the period 1980-1984 provided by NCPC. Monthly peak demand and load factor values derived from these data resulted in the statistics presented in Table 3.1 and Figure 3.

Future electrical generation was forecast under three scenarios:

CASE A - 0 percent load growth

CASE B - 1.6 percent load growth - based on a long term forecast developed by NCPC in their report titled, "Forecast of Electric Energy Requirements in the Yukon Territory and the Northwest Territories 1982/83 - 2002/03"

CASE C - Growth at 70 kW per year - a short term forecast proposed by NCPC in their September 11, 1984 letter to YECL. This case is developed by adding 70 kW to the yearly peak (August) and then adding to the other monthly peaks on a proportionate basis.

In addition to electric energy, the existing diesel plant also supplies waste heat to three categories of heating loads:

(1) space heating to several buildings in the area

(2) domestic water supply heating to keep the water line thawed during the winter months, and

(3) heat to the swimming pool during the summer months.

In order to obtain the total energy requirements, it is necessary to add the waste heating loads to the electric energy load. The diesel case (status quo) has a different growth rate for total energy than the hydro/diesel cases. The diesel plant supplies heating loads as a by-product of electric energy generation. The hydroelectric plant must meet these loads as part of the electrical generation and may require extra capacity and energy in order to supply the same total load. The heating load in 1984 was about 6.6 TJ.

These heating loads are assumed to remain constant with the exception of the domestic water-supply heating load which is increased at 0.8 percent per year for both the 1.6 percent and 70 kW growth cases. No increase was applied in the 0 growth case. The heat load, electric load, and total load are tabulated monthly for each case of the study. The tabulations are found in Appendix B.

TABLE 3.1

BASE YEAR ELECTRICITY DEMAND AT DAWSON

	Peak Demand kW	Energy MW.h
January	1330	699.9
February	1306	625.2
March	1147	617.6
April	1155	602.4
May	1217	622.6
June	1324	674.4
July	1366	720.1
August	1436	764.9
September	1432	740.1
October	1313	717.8
November	1257	663.3
December	1390	787.5
		8235.8

The base year load characteristics were derived from 1980 to 1984 generation data and represent the magnitude of loads as of 1984.

4 - HYDROLOGY

4.1 Water Supply

There are three hydrometric stations operated by Water Survey of Canada within the Klondike River basin. The first station (No. 09EA003) was established in mid 1965 on the Klondike River near its mouth. The second station (No. 09EA004) was established in mid 1974 on the North Klondike River approximately 20 m upstream of the North Fork Canal Intake and the right bank of the river. A station has recently been established on the Little South Klondike River (No. 09EA005) but the few records available to date were considered to cover too short a period for inclusion in this study. The locations of these are shown on Figure 1. Other gauged watercourses on the periphery of the basin also have very short periods of record. Hence, only data from the two stations with long periods of record were considered in this study.

The water supply analysis was based on the period January 1966 to December 1982. The more recent 1983 data were not available at the beginning of the study. A linear regression was performed between the logarithms of the mean monthly discharges of the Klondike River (09EA003) and the North Klondike River (09EA005) stations in order to extend the effective period of record for the North Klondike station. The correlation coefficient was computed as 0.98 indicating an excellent relationship between the discharges at the two stations. It was assumed that the same relationship would also apply to the mean daily discharges at these stations. Using the computed regression coefficients, the missing daily discharges on the North Klondike River were reconstructed. The few missing discharges for the Klondike River during the summer of 1973 were reconstructed by inspection.

Local daily inflows into the North Fork Canal and into the South Fork Canal were reconstructed by prorating on a drainage area basis with the discharges of the North Klondike River. Similarly, the mean daily discharges in the Klondike River at the South Fork Intake were reconstructed using the Klondike River flows near the mouth. Therefore, sequences of mean daily discharges from 1966 to 1982 were available for the Klondike River at the South Fork Intake, for the local inflow into the South Fork Canal, for the North Klondike River at the North Fork Canal Intake, and for the local inflow into the North Fork Canal.

4.2 Simulation Studies

The power generation available from the system was simulated for the period 1966 to 1982 using the daily flow sequences developed as described in the preceding section. The capacity of the South Fork Canal was set at 3.0 m^3/s and that of the North Fork Canal was set at 4.0 m^3/s. Losses along the South Fork Canal were assumed as 10 percent of the inflow and along the North Fork Canal as 5 percent of the inflow. These losses were to account for infiltration through the canal bank as well as inefficiencies in operation. The order of priority in which water was withdrawn was: North Fork Canal local inflow, the North Klondike River, the South Fork Canal local inflow, and finally the Klondike River at the South Fork Canal Intake. Since the rates of change in demand were relatively small, lag times of routing the flows were not considered.

During most of the year, large quantities of water would be passed through the control structures on the Klondike River and the North Klondike River. No minimum rate of spill was stipulated for these studies. Any requirements for minimum riparian flows in the affected river reaches would be established in later studies. The generating units were assumed to operate under a net head of 65 m with an overall efficiency of 85 percent. Three developments were considered:

- a development with an installed capacity of 1000 kW using the flows available from the North Klondike River together with local inflows into the North Fork Canal. This was designated the North Fork 1000 kW Development.
- the same North Fork Development but with an installed capacity of 2000 kW. This was designated the North Fork 2000 kW Development.
- the same power installation as the North Fork 2000 kW development with an extended flow diversion system which would provide a supplementary supply of water from the Klondike River and from local inflows into the South Fork Canal. This was designated the North and South Fork 2000 kW Development.

The component structures of these developments are described in Sections 6 and 7 and are located as shown in Figure 2. The operation of each of these developments was simulated for the 17 years of flow records. In the simulation, the plant was operated at full load to the extent possible, limited only by the water supply available. Variations in daily or seasonal demand were not considered. The results of the simulations are summarized in Table 4.1.

TABLE 4.1

AVAILABLE GENERATION SUMMARY

Development	Installed Capacity (kW)	Average Available Output (kW)	Minimum Available Output (kW)	Proportion of Time Full Capacity Available (%)
North Fork	1000	989	623	92.6
North Fork	2000	1685	623	57.2
North and South Fork	2000	1999	1916	99.6

A detailed examination of the results of analysis of the North Fork 2000 kW development showed that the simulation failed to meet the demand during January to March 1974. During the same period in 1970, the demand was just satisfied. Though riparian releases were not considered as part of the study, it was noted that during May to October, there would be very large spillage which should satisfy any downstream requirements. During the same period, flows on the Klondike River would be essentially natural. During the winter months, there would always be some spillage on the Klondike River except for the dry conditions that occurred in 1970 and 1974. For the North and South Fork 2000 kW development, the results showed that the demand could not be met during late fall to the beginning of the spring freshet. Once the spring freshet starts, there is more than sufficient flow in the North Klondike River to satisfy the demands during the spring, summer and early fall months. For the North Fork 1000 kW development, the results showed that the demand could be met at all times from May to December inclusive. However, for the majority of the years, it was found that the demand could not be fully met at all times during the months January to April. For each development, duration curves of power output were computed for the year and for each month. These are shown on Figures 4 to 13.

The simulations leading to Figures 4 to 13 are specifically related to the installed capacities which were studied. In order to provide more general flow duration data which might be used in evaluating other installed capacities, an additional set of curves was developed for the case of unlimited installed capacity and these are presented in Appendix C.

4.3 Flood Hydrology

Using the records published by Water Survey of Canada, flood frequency curves of annual peak discharges were prepared for the two hydrometric stations in the basin. A log normal distribution was assumed. The data used are reproduced in Table 4.2.

TABLE 4.2

PEAK ANNUAL DISCHARGES KLONDIKE RIVER BASIN - m^3/s

Year	Klondike River Station No. 09EA003		North Klondike River Station No. 09EA004
	Daily	Instantaneous	Instantaneous
1966	433	-	-
1967	411	-	-
1968	357	-	-
1969	286	-	-
1970	343	-	-
1971	476	-	-
1972	640	-	-
1973	-	-	-
1974	317	326	-
1975	544	-	95
1976	374	-	86
1977	425	-	89
1978	210	228	64
1979	408	-	90
1980	360	-	97
1981	308	308	87
1982	416	422	137
1983	468	491	163

For the North Klondike River, the frequency curve was computed using instantaneous peak discharges. For the Klondike River instantaneous peak discharges were available for only a few years. Hence, this frequency curve was computed using mean daily discharge data. A comparison of the limited flood data showed that the instantaneous peaks averaged about four percent higher than the mean daily peak. The computed frequency curve was therefore adjusted upward by this amount to reflect instantaneous peaks.

Using the two frequency curves, floods having return periods of 10, 100 and 500 years were plotted against the drainage area on log-log paper for each station as shown on Figure 17. From this resulting regional flood frequency curve, design floods at other locations in the basin were estimated.

The North Fork Spillway and North Fork Canal Spillway have been sized to pass floods having a return period of 1:500 years. From the system simulation studies described in Section 4.2, it was found that after the start of the spring freshet, power demand could be satisfied for the summer using North Klondike River flows only. Hence, if structures along the South Fork Canal or at the South Fork Canal Intake were damaged by spring or summer floods, they could be repaired by the time they were needed for winter operation. Hence, these structures were only designed for floods having a return period of 1:100 years. The resulting design flood discharges are tabulated in Table 4.3.

TABLE 4.3

DESIGN FLOOD DISCHARGES

Structure	Discharge (m^3/s)	Return Period (year)
South Fork Diversion Weir	480	1:100
Lee Creek Spillway	60	1:100
North Fork Spillway	220	1:500
North Fork Canal Spillway	14	1:500

5 - TRANSMISSION REQUIREMENTS

The transmission line from the North Fork hydroelectric plant to Dawson would be a 25 kV, 3 phase line with no neutral. It would be supported on wooden poles with spans of about 100 m.

The line would utilize the existing poles from Dawson to Rock Creek, a distance of 19 km. Most of this is presently only single phase and would have to be upgraded to 3 phase. The existing line is in generally good repair, having been built or rebuilt during the last few years. From Rock Creek the line would continue east along a new right-of-way parallel to the highway to a point approximately straight south of the power plant. From this point it would turn north, cross the Klondike River and continue on to the plant.

For the most part, the floor of the Klondike River valley is composed of gravels and there should be few problems with access or construction. Pressure treated poles would be used in the construction of the line. This would cure the past problems of poles rotting off at ground level. The new line would have a thermal capacity in excess of 10 MW. Therefore, there would be no problem carrying the full output of the proposed plant.

6 - NORTH FORK DEVELOPMENT

This project would use the flows available from the North Klondike River and from the local drainages flowing into the North Fork Canal. It would comprise a 10 km canal followed by a 492 m long surface penstock to convey the water from an intake on the river to a powerplant in the Klondike River valley. The river flows would be diverted by a low embankment dam located 8.5 km upstream from the confluence of the North Klondike River and the Klondike River. A spillway would be included to pass river flows in excess of those required for power generation. A second spillway at the downstream end of the canal, near the Power Intake, would handle excess flows entering the canal from minor drainages on the north side. The location of these project facilities is shown on Figure 2.

The operation of the system would be as follows:

North Fork Spillway

The openings controlling the flow over the spillway (and consequently the water level in the diversion forebay) would be adjusted on a monthly or weekly basis to control forebay water levels with an acceptable operating range. Flood flows would pass over the spillway.

North Fork Canal Intake

The intake gates would be operated by remote control to maintain the required rate of inflow to the canal. Changes in flow will probably be limited to an hour-to-hour or shift-to-shift basis.

North Fork Canal Spillway

The spillway near the powerhouse would provide automatic protection to the plant in the event of load rejection or other emergency condition. It would not normally be activated.

Turbine Pressure Relief Valves

Minute-to-minute variations in water needs by the turbines would be achieved by varying the amount of flow released through bypass valves which will protect the unit and the penstock from over pressure loads.

The need to vary loads at the plant can be minimized during the water heating season by using the load of the electrical boiler to even out small variations in total demand on the plant, thus enabling the water flow through the hydraulic plant to be kept quite constant.

As a general principle, this study has been based on the premise that where economic, the project should be reconstructed for automatic remote controlled operation with a minimum of planned maintenance and should utilize existing structures and facilities to the maximum extent practical. At the same time, the designs should minimize capital costs. For these reasons, the intakes would be equipped with remote controlled gates whereas the spillways would be designed for stoplog operation. The exception to this would be at the North Fork Diversion Spillway where a minor amount of daily adjustment to the discharge capacity would be necessary. A gated section would be included for this purpose. It is envisaged that the operating crew could be supplemented by casual labor whenever the discharge capacity of the spillways need adjusting by adding or removing stoplogs.

It was concluded, following the site inspection, that only the North Fork Diversion Dam, the North Fork Canal, the powerhouse and the tailrace channel could be economically rehabilitated and used for the proposed redevelopment project. All other structures would be replaced with concrete and steel structures. New turbines, generators, and other electrical and mechanical equipment would be required.

The location and purpose of various structures required for the proposed redevelopment are identical with those of the previous project. The existing structures and their current condition are described in Section 2. Each of the proposed project structures are described in this section.

6.1 Description of the Proposed Structures

6.1.1 North Fork Diversion Dam

The existing 700 m long and 2.5 m high embankment dam is located in the sketch plan on Figure 18. It follows the south bank of the river between two bends, and terminates at the downstream end at the North Fork Spillway. The earthfill dam would be rebuilt as shown in the section on Figure 18. The steep upstream face, that has been eroded at its toe by the river, would be excavated to a stable slope of 1 vertical to 2.3 horizontal. The upstream face would be protected by a layer of riprap obtained by screening the river bed gravels. The downstream slope would be flattened to a slope of 1 vertical to 2 horizontal. The 5 m wide crest would be topped with a surface gravel layer suitable for vehicular traffic. If necessary, the dam would be raised to ensure that there would be adequate freeboard above water levels corresponding to the design flood for the North Fork Spillway.

6.1.2 North Fork Diversion Spillway

The North Fork Diversion Spillway would be designed to pass 220 m^3/s and would be located at the site of the existing spillway as shown on Figure 19.

The North Klondike River would be diverted during construction by building a cofferdam across the river channel upstream of the spillway and breaching the North Fork Diversion Dam (see Figure 18) near the old river channel to the east and a secondary channel further to the west. Both of these channels by-pass the spillway and return to the river some 500 m downstream. Which channel would provide the better diversion would be decided after topography of the area is obtained.

The existing remnants of the timber spillway would be removed and an entirely new structure would be built in its place. The conceptual design of the spillway is shown on Figure 20. Its location relative to the North Fork Intake is shown on Figure 19. The spillway would consist of five 4 m wide bays equipped with stoplogs together with two further bays of 2 m width located at the right side equipped with remote controlled vertical lift gates. The latter would permit the spillway discharge to be adjusted by the operating staff remotely to maintain a relatively constant river level at the North Fork Intake. Major flood discharges would be handled by manually adjusting the stoplogs.

The spillway would be a concrete structure founded on the riverbed. The piers and slabs would be of substantial thickness to provide stability against sliding and overturning under the combined thrust of the water, ice, and earthquake loads. The base of the spillway would be insulated to minimize the adverse effects of freezing of the foundation. The project access road would bridge the river on the downstream end of the spillway. Sheet pile retaining walls would support the river bank in the vicinity of the spillway on both the upstream and downstream sides. Some of the existing sheet pile walls would be retained as shown on Figure 19. The riverbed would be protected from scour by a riprap layer immediately downstream of the spillway.

The fabricated steel stoplogs, which would weigh less than 1500 kg each, would be handled using a gantry structure with an electrically powered hoist running on a monorail. Operating staff would manually guide the stoplogs between the slots and the storage area on the left side. Access for the staff would be on a gallery downstream of the gantry structure. A second set of stoplog slots would be provided on the upstream side to allow maintenance and repairs of the operating stoplog slots.

The two vertical lift roller gates would be raised and lowered by means of electrically powered screw hoists. Stoplog slots upstream of the gates would permit maintenance and repairs to the gates. Two gates are considered preferable to a less costly larger single gate because they would permit finer adjustments to be made to the spillway discharge, even with one gate inoperative. Also, in the event of a power failure, the lighter gates can be more readily operated manually.

During the winter months, the spillway bays would be closed with stoplogs to the minimum elevation needed to divert 4 m^3/s flow through the North Fork Intake. A 1 m operating range would be required. The two gates would be in their fully closed position. Any minor excess flows that might arise would spill over the top of the stoplogs. As the gates would only be operated during the summer, the gate guides would not be electrically heated and the hoist would not need to be protected with a gatehouse.

For the purpose of this study, it has been assumed that power for operating the spillway gates would be provided by a 20 kW diesel generator located to the right of the North Fork Intake as shown on Figure 19. This generator would run continuously and would need to be regularly maintained. The generator building would also house the remote control equipment. Alternatively, a powerline could be built along the canal from the powerhouse to provide energy for gate operation and electric heating. Commands to operate the gate would be transmitted by radio from the Powerhouse to the North Fork Intake.

Allowance has been made for a fish ladder as shown conceptually on Figures 19 and 20.

6.1.3 North Fork Intake

The location and details of the North Fork Intake are shown on Figure 19. The existing timber intake and bridge would be replaced in their entirety. The new intake would be a concrete structure located in the centre of the entrance to the North Fork Canal. Flow into the canal would be regulated by two 1.2 m high by 1.2 m vertical lift gates remotely controlled by radio from the powerhouse. As with the spillway gates, two gates were selected in preference to a single larger gate to permit finer control and continuous operation even with one gate inoperative. The smaller gates are easier to operate manually in the event of a power failure. Each gate would be raised and lowered by an electrically powered screw hoist.

The gate guides would be electrically heated continuously during the winter months. Waste heat from the motor cooling system and from the exhaust would also be collected for gate heating. Stoplog slots would be provided on both the upstream and downstream side to facilitate repairs and maintenance of the gates. Both gates and stoplog slots would be located within an insulated gatehouse that could be heated by the waste heat from the generator and by supplementary electric heaters, when repairs are necessary during the winter. Removal of the gates for repairs or replacement would be through a hatch in the gatehouse roof. Trashracks would be placed upstream of the gates. These would be cleaned by hand. Thick concrete slabs and piers would provide the necessary weight to resist sliding and overturning under water, ice, and earthquake loads.

Automatic water level recorders would give the powerplant operators data to adjust and select the appropriate gate openings for the required canal discharge. Water level data would be transmitted by radio to the powerhouse.

The existing canal on both sides of the new intake would be backfilled with a pervious nonfrost-susceptible fill contained between sheet pile walls as shown on Figure 19. The canal invert would be protected from scour by a riprap layer immediately downstream from the intake. On the left would be access to the intake and spillway and on the right the generator building and fuel tanks. A bridge would be located on the downstream edge of the intake for access to the generator building.

The North Fork Intake would be constructed while the river is diverted for the North Fork Spillway construction.

6.1.4 North Fork Canal

The 10 km North Fork Canal is shown in plan on Figure 2. The existing canal would be cleared of willows and other vegetation and the canal banks would be flattened where necessary to a stable slope. This slope would probably be 1 vertical to 2 horizontal and this value has been adopted for costing purposes. The actual slope required for stability would depend on the soil type. Typical stabilization of the canal banks is shown on Figure 21. The surveys carried out by NCPC during 1975 and observations of the soil types along the canal during the site inspection, indicate that little bank stabilization will be necessary and only a limited amount of canal bank rebuilding has been allowed in the cost estimate. Where slopes are flattened, the excavated spoil, if suitable, will be used together with additional fill to reconstruct sections of the left canal bank that has been washed out or eroded as shown on Figure 21.

The existing slope of the canal invert is too steep along most of its length to maintain a low enough velocity during freeze-up for a stable ice cover to develop. The past records of the project and details provided by Mr. N. Webster are replete with descriptions of the difficulties experienced each year with frazil ice developing before an ice cover could be estabished. Many manhours of effort were expended draining off the slush ice and breaking up hanging ice dams during this critical period. The considerably lower canal flows of 4 m^3/s for the present project would allow an alternative, less labor intensive, approach to be taken. It is proposed that four check weirs would be constructed, tentatively located as shown on Figure 22. These weirs would reduce the maximum canal velocity to below 0.6 m/s and would encourage an ice cover to form without frazil ice being generated. The water would probably remain open immediately downstream of the crest throughout the winter.

Typically the weirs would be constructed of sheet piles and gravel fill from the Klondike River bed and would have a cross section as shown on Figure 21. A height of 2 m has been selected for this study. Riprap would be placed on the canal banks and downstream of the weir to protect against scour from locally high velocities. After a detailed survey of the canal is available the number, location and height of the weir would be optimized for greatest effect. Each weir would be designed individually.

The locations for these weirs were established by open water hydraulic gradient computations using the cross-sections surveyed by NCPC in 1975. Starting from the Power Intake, the hydraulic gradient was computed upstream until the velocity in the canal equalled approximately 0.6 m/s at a discharge of 4 m^3/s. A weir was assumed at this location. Using the weir formula, the water level immediately upstream of the weir was determined. The hydraulic gradient computation was then continued upstream until the velocity again equalled 0.6 m/s, identifying the next weir location. This continued until all weir sites were located. The resulting water surface profile is shown on Figure 22.

To determine the effects of the weirs on the ultimate carrying capacity of the canal, the hydraulic gradient was also computed for a discharge of 20 m^3/s. (For this test, the restriction imposed by the Dempster Highway crossing was assumed to be removed). As shown on Figure 22, the canal would continue to have a very large flow carrying capacity even with the weirs installed. However, unless the weirs were constructed of very large stones, some damage to the weirs would be contemplated in such an event.

Seepage losses from the canal were reported and an effort would be made to locate any major concentrated flows by a detailed survey downslope from the canal. If any such readily identifiable seeps are found, the economics of sealing them would be studied. No allowances have been included for such mitigative measures in the capital cost estimate. Allowance was made, however, for a nominal overall water loss from seepage in the power flow analyses.

6.1.5 Dempster Highway Crossing

A corrugated metal pipe arch culvert would be placed through the Dempster Highway embankment where it crosses the North Fork Canal. The pipe arch has been tentatively sized at 3 m wide by 2 m high for costing purposes. The culvert would pass normal canal flows of up to 4 m^3/s partially submerged. It would also be capable of passing the design flood discharge which, at that point in the canal, is approximately 7 m^3/s.

6.1.6 North Fork Canal Spillway

The spillway would be designed to pass the 14 m^3/s flood flows arising from the local drainages to the north of the canal and downstream of the North Fork Intake. Two alternatives were considered. The first would comprise rebuilding a spillway at the location of the previous structure. The second considered the use of the three existing buried penstocks that would otherwise be abandoned. The former scheme was used as a basis for this study. It represents a more reliable solution considering the present state of knowledge of the topography and subsurface conditions down the path of the spillway chute as compared with that of the condition of the rivetted steel penstocks. Use of the existing penstocks would initially be the least costly approach but the possibility of a future collapse of one or more of the penstocks, which are in an advanced state of deterioration, was recognized. In that event, an alternative spillway would then have to be constructed, probably at the site of the North Fork Canal Spillway.

The existing spillway would be replaced with a single bay, concrete spillway equipped with stoplogs as shown in Figure 23. The water passage would be 3 m wide through the stoplog section and would expand to a 3.5 m wide spillway chute with 1.5 m high walls. The chute would control flood flows down the steep slope below the canal until they discharge into the relatively flatter existing creek bed leading to the Klondike River. The spillway chute would terminate in a stilling basin with 4 m high walls containing dentates and a downstream riprap protected section. Figure 23 shows the location of the existing spillway chute that is curved in the plan. The straight chute proposed, which would involve a substantial amount of excavation, can be justified on the grounds of its better hydraulic performance and more economical use of concrete.

The base of the spillway and the chute would be insulated to minimize any frost heaving. The canal bank on either side would be retained with sheet pile walls. The canal access road would bridge the stoplog structure across its downstream end.

The fabricated steel stoplogs, which would weigh less than 1000 kg each, would be lifted and lowered by means of an electric monorail hoist supported on a gantry across the structure. A power supply would be required to operate the hoist. Stoplogs would be stored at the upstream side of the structure. An access gallery for handling stoplogs would be located upstream of the bridge. Maintenance and repairs to the stoplogs slots would be carried out by placing the stoplogs in a second set of slots on the upstream side.

6.1.7 Power Intake

The Power Intake leading into the penstock would be located to the left of the existing Pressure Box intake to the three existing penstocks. The proposed location and other details of the Power Intake are shown on Figure 24. The intake would be a concrete structure with a concrete paved approach. The invert would be set lower than the invert of the canal to ensure that there would be sufficient head above the bellmouth to prevent formation of vortices. The intake would provide a water passage transition from a rectangular section to the circular section of the penstock.

Flow into the penstock would be controlled by a single 1.2 m by 1.2 m vertical lift gate remotely operated from the powerhouse. The gate would be lifted by means of an electrically driven screw hoist. Stoplog slots would be included to allow servicing and repairs of the gate using the same steel stoplogs used for the North Fork Intake. The gate guides would be electrically heated. Trashracks would prevent debris from entering the penstock. These would be cleaned manually. An insulated gatehouse would be provided that could be heated for maintenance and repairs during the winter. Electric power would be supplied by a pole line from the powerplant. Gate control and water level recording telemetry would use the same pole line.

The existing intakes to the penstocks would be sealed with impervious fill across the mouth of the pressure box on the upstream side to form a extension of the canal bank which would terminate at the right timber retaining wall as shown on Figure 24.

6.1.8 Penstock

Water would be conveyed down the slope through a 1.2 m internal diameter, insulated, steel penstock located on the south side of, and parallel and adjacent to, the existing penstocks as shown in Figure 25. Clearing of trees and vegetation would be required. The penstock would be buried for the first 10 m downstream of the Power Intake. From the first support, it would be exposed, initially in an open trench until it emerged above ground surface as the slope drops down towards the Powerhouse, and then it would generally follow the surface of the slope. The penstock would be supported every 10 m of length on piles which would be either driven or socketted into augered holes, if the soil and permafrost conditions prevent pile driving. At changes in direction, the penstock would be anchored as shown on Figure 25.

The hill slope between the Power Intake and the Powerhouse is reported to be actively unstable, although no evidence of major landslide scars were observed during the site inspection or on the aerial photographs. The instability was stated to have been the contributing cause of the penstock failures which were regular occurrences in the past. It is suspected that this reported instability is a solifluction process probably associated with the annual freeze and thaw cycle. Such shallow slope movement could have induced strains in the penstock resulting in successive failure of rivets followed by leakage from the penstock and a washout of the slope. This is supported by the observation during the site inspection that the penstocks are currently separated at the centre expansion joint indicating that an overall extension of the penstock has occurred.

The proposed design would maintain the new welded penstock above ground surface where it can be regularly inspected and any movement detected and corrected by adjustments at the supports and at the anchors. Both the supports and anchors would be founded on piles driven to a depth well below the zone of downslope movement. Frost heave and frost penetration would be limited by the inclusion of insulation and an air void beneath the pile cap. An above-ground penstock is preferred considering the present state of knowledge of the subsurface conditions down the penstock slope. A buried penstock could be considered if the conditions during an investigation are found to be less severe.

Overall, the penstock would be 492 m long from the Power Intake to the upstream Powerhouse wall. At the Powerhouse, the penstock would bifurcate to two buried 600 mm internal diameter penstocks leading to the two turbine units.

6.1.9 Powerhouse

The existing Powerhouse building would be suitable to be used for the redevelopment. The massive concrete turbine and generator foundations are reported to be founded on bedrock and have settled little, if any, during the past 75 years. Certainly the foundations would be more reliable with respect to settlement than an inexpensive new foundation on overburden. A new foundation could be subject to displacement if it were founded on soil, particularly if the soil was permafrost affected and would probably be costly if it were to be taken down to bedrock. Neither the presence of permafrost nor the condition of any foundation soils could be determined during the site inspection. A disadvantage of using the existing Powerhouse is its size and the cost of upkeep on this large building during the life of the project. On balance, it is expected that use of the existing Powerhouse would prove to be less expensive than constructing a new building. Therefore, this alternative has been assumed for this preliminary study. It will be necessary to take into account the interests and wishes of the present owner of the property in making the final choice of location and form of development. It is not expected that a modern, low maintenance hydroelectric power installation will prove to be disruptive or offensive in this setting.

The powerplant would be installed in the southern third of the existing Powerhouse as shown on Figure 26 to minimize heating requirements and to limit the area that would be rehabilitated. An insulated wall with a sliding door would be built separating the new Powerhouse from the remainder of the building. The existing travelling bridge hoist would be retained. Some minor renovations to the building would be necessary to bring the insulation up to modern standards and to repair the cladding.

The turbine-generator block would be used with minor modifications. The block would probably need to be reinforced to compensate for any structural deterioration of the concrete including the minor cracks reported in the block. The top of the foundation block would be levelled by the addition of a layer of concrete beneath generator No. 1. A new extension of the block would be cantilevered beneath generator No. 2. The existing floor would be removed to accommodate the extension. Handrails and stairs would be added around the turbine-generator pit.

The new units would be connected to the existing draft tubes at the embedded collars at machine floor level. The previous unit had two draft tubes and these are conveniently located for both the new units as shown on Section AA of Figure 26. The new pressure relief valves would be spaced to connect with the existing discharge passages to the tailrace conduit.

6.1.10 Powerplant

Two 1067 kW (1450 metric horsepower) Francis turbines rated at 65 m operating head, would be provided. The unit generators would be rated at 1000 kW output each. Each turbine would discharge 2 m^3/s at full output under the rated head. The turbine dimensions are based on a synchronous speed of 900 r/min and a throat diameter of 490 mm. The units would have a specific speed of 154.2 (metric). The scroll case and draft tubes above machine floor level would be of steel. Control valves would be located in the penstock immediately upstream of the units. The new units would be equipped with pressure relief valves to by-pass flows at load rejection and to spill excess water. The valves would be operated at full discharge before load acceptance to control penstock surging. It is anticipated that the system could handle surges at load rejection and load acceptance without surge tanks. This assumption is supported by the experience of the previous project which did not have surge tanks. In addition, the proposed operation of the system, which would use power to heat water during periods of low demand, would have the effect of smoothing out demand at the powerplant.

6.1.11 Tailrace Weir and Channel

There is a gentle drop over the 2.5 km from the Powerhouse to the Klondike River, and it would be necessary to place a weir immediately downstream of the Powerhouse to maintain the minimum tailwater level required to prevent cavitation in the turbines. The timber crib tailrace dam used for the previous power development would be removed in its entirety and would be replaced with a weir constructed of sheet piles and faced with gravel and cobbles from the Klondike River. The weir would have the section shown on Figure 27. No topography is available of this area but it has been assumed that the tailrace pond would require no further dyking. The existing tailrace channel to the Klondike River would be cleared of vegetation and the side slopes flattened, where necessary, to at least 1 vertical to 2 horizontal.

6.2 Construction Materials

No survey of the availability of construction materials has been conducted beyond observations during the site inspection. It has been assumed that a concrete batch plant would be set up near the North Fork Intake and Spillway. Concrete aggregates would be obtained by washing and screening river gravels from the North Klondike River. Suitable material can be found both upstream and downstream of the North Fork Diversion Dam. Similarily, the large size gravel and cobbles required to construct the canal weirs, to rebuild the North Fork Diversion Dam and to provide riprap river bed protection would be obtained from the same sources. Impervious material for rebuilding the canal bank and for the fill areas around the North Fork Intake and Spillway would be obtained from the talus deposits along the canal route.

7 - NORTH AND SOUTH FORK DEVELOPMENT

The scheme to rehabilitate the entire hydroelectric development by supplementing the North Klondike River flows during the winter months with water from the Klondike River, has also been considered. The project features described in Section 6 for the North Fork Development would be included in this scheme. The additional flows would be diverted from the Klondike River at the site of the previous intake and would be carried along the 26 km long South Fork Canal to discharge into the North Klondike River 1 km upstream of the North Intake as shown in Figure 18.

The development would entail additional features. A permanent diversion weir is considered to be more appropriate than the time-consuming and labor intensive construction of an ice dam across the South Klondike River each fall. A new intake would be required to control inflows to the canal. The spillway at Lee Creek would be rebuilt and would have the capacity to discharge all flood flows arising upslope from the South Fork Canal from local upstream drainages including Kerr Creek. All flood flows into the South Fork Canal downstream of the Lee Creek Spillway would be allowed to discharge into the North Klondike River and would be passed through the North Fork Spillway. The Kerr Creek, Shovel Creek, and North Fork Point spillways would not be used. This approach can be adopted for the project because the combined flood flows with a return period of 100 years along both reaches of the canal could be adequately passed without overtopping of the existing canal bank with the canal weirs in place. This can be seen by comparing the backwater curves plotted for canal flows of 20 m^3/s on Figure 22 with the left canal bank profile. The need to discharge part of the floods at Kerr Creek, Shovel Creek and at the North Fork Point spillways is thus obviated.

7.1 Description of the Structures

7.1.1 South Fork Diversion Weir

The weir would be located across the Klondike River just downstream of the existing intake channel as shown on Figure 28. The purpose of the weir would be to permit a continuous ice cover to develop upstream and over the intake approach channel. The weir would not be required during the summer when sufficient flows could be diverted from the North Klondike River alone to satisfy the power demand.

The weir would consist of three basic parts. A gravel and cobble fill section with a cross section as shown on Figure 28. The cobbles and gravel would be obtained from the river bar adjacent and would be dumped into the flowing water. Large size cobbles would be deposited on the downslope face and in a dredged out part of the river bed immediately downstream. It has been assumed in the absence of any topographic and bathymetric data that the weir would have an average height of 2 m above the present river bed.

Across the deepest river section on the right side, a sluice would be constructed with ten 5 m wide openings equipped with stoplogs to the crest elevation of the weir. During the summer, the stoplogs would be removed to allow sediments accumulated during the winter months to be passed and to allow free passage for fish. Details of the sluice are shown on Figure 28. The sluice would be a concrete structure constructed behind a dewatered cofferdam. It is anticipated that sealing the pervious river gravels to effectively dewater the excavation would be difficult and would represent a significant construction cost. The 12 m width of the sluice section is principally required to resist the forces imposed by moving ice floes during the early part of winter. A bridge across the top would provide access for a portable crane to lift and lower the stoplogs. Further stoplog slots would be located upstream and downstream to permit maintenance and repairs to the operating stoplog slots. The stoplogs would be simple wide flange I beams that would raise the river level upstream even though some leakage would occur between the beams. Such stoplogs would be effective and considerably less costly than the fabricated steel stoplogs proposed for the other spillways on the project. A riprap pavement would be placed downstream of the sluice as a continuation of the weir.

Access to the bridge on top of the sluice would be over a non-overflow dam section between the sluice and the right river bank. This would be constructed of river gravels from an adjacent source, which would be placed and compacted in the dry behind the cofferdam.

7.1.2 South Fork Intake

The existing intake would be used as a cofferdam during construction after which it would be demolished and removed. The new structure would be located as shown on

Figures 28 and 29 and would be similar in most respects to the North Fork Intake. It would be a concrete structure with two 1 m by 1 m vertical lift gates operated remotely from the powerhouse. The gates would be raised and lowered by electrically powered screw hoists. Electric power would be generated by a 20 kW diesel set in a separate building located to the north of the intake. The building would also house the remote control equipment. Commands to operate the gate would be transmitted by radio from the Powerhouse. The intake would be enclosed with an insulated gate house with heaters for cold weather repairs and maintenance.

The gate and gate guides would be heated electrically and also by circulating waste heat from the generator cooling and exhaust systems. Stoplog slots on both sides of the gates would allow maintenance and repairs to be carried out. Trashracks upstream of the gates would prevent debris from entering the canal. These would be cleaned manually.

The concrete members would be thick to provide the weight necessary to resist sliding and overturning due to combined ice and hydrostatic loads. The canal downstream of the intake would be protected by riprap.

The intake would be located in the centre of the existing canal. The gaps between the canal banks and the intake would be filled to floor and bridge elevation between sheet pile retaining walls.

7.1.3 South Fork Canal

The existing 26 km long canal would be cleared of vegetation and the banks would be flattened where necessary to a stable slope in a similar manner to that for the North Fork Canal as shown on Figure 21. The two sections of the canal where the canal banks have been washed out would be rebuilt. These are near the South Fork Intake where the Klondike River has apparently eroded a channel into the canal and at a point between Lee Creek and the intake.

Ten sheet pile gravel fill check weirs would be placed at the locations shown on Figure 22. These would reduce the canal velocities to less than 0.6 m/s so that a stable ice cover can form early during freeze-up and prevent formation of frazil ice.

Location of these weirs was determined in the same manner as with the North Fork Canal, except that the lower discharge of 3 m^3/s was used. The profile for a discharge of 20 m^3/s was also computed to illustrate the freeboard adequacy for flood flows. The 3 m^3/s and 20 m^3/s water surface profiles are shown on Figure 22.

7.1.4 Lee Creek Diversion Dam and Spillway

This spillway would be similar to the North Fork Spillway as shown on Figure 30. It would have three 4 m wide bays equipped with fabricated steel stoplogs. A second set of stoplog slots would permit repairs and maintenance to the control stoplog slots. The stoplogs would be inserted and removed by means of an electric hoist running on a monorail gantry. A portable generator would be used. Access across the river and spillway would be by a bridge on the downstream end of the structure. Sheet pile retaining walls would support the river bank adjacent to the spillway.

The new structure would be located at the site of the previous spillway. A cofferdam would be built to divert Lee Creek through the existing emergency spillway during construction of the new spillway. Remnants of the existing timber structure would be removed. The existing timber crib dam to the west of the river would also be removed to accommodate the new longer structure and would be replaced with the new earthfill diversion dam. The previous emergency spillway structure would be removed after the river is returned to its natural course. The structure would be replaced with a continuation of the diversion dam as shown on Figure 30.

7.2 Construction Materials

The distance between the South Fork Intake and the North Fork Intake, where it is proposed to locate a concrete batch plant, is some 26 km. Therefore, for this development, the batch and screening plants would be relocated to the vicinity of the South Fork Intake after the concrete work on the downstream structures has been completed. Concrete aggregates would be obtained by screening and washing river gravels near the South Fork Intake. Fill for the non-overflow section of the South Fork Diversion Weir and riprap would also be obtained from this source. Impervious fill for canal repairs and backfill around the intake and spillway would be taken from talus and glacial till deposits along the canal route.

8 - CAPITAL COST ESTIMATE AND SCHEDULE

The capital cost estimates for the three development cases considered are presented in Tables 8.1, 8.2 and 8.3. Table 8.4 shows the incremental cost of the South Fork structures if they were to be constructed some time after the North Fork Development as a staged development.

8.1 Basis of the Estimate

The capital cost estimate is based on unit prices developed for this study. The unit prices take into account the quantities of construction materials involved and unit prices tendered on similar projects constructed in northern Canada. Also considered are the construction schedules shown on Figures 31 and 32 and an evaluation of the labor, materials and construction equipment required to execute the work. The northern location of the project has been allowed for as it will affect productivity, transportation costs, timing and construction methods. The cost estimating criteria used for the study are:

- costs have been presented in terms of prices prevailing during the 1984 construction season. No allowance has been made for escalation or interest on funds required during construction (AFUDC). An allowance has been made for applicable taxes.

- the construction schedule assumes a 11 month construction period from the award of the civil work contract to the end of commissioning.

- it is not anticipated that a construction camp will be necessary, however, a subsistance allowance of 5 percent has been included in the unit prices.

- contingency allowances of 20 percent for civil works and 15 percent for electrical works have been used. These contingency allowances reflect the different degrees of uncertainty and extent of available knowledge at the time of the study.

- transmission line costs were estimated by YECL using current unit prices for this class of work.

- an allowance has been included to cover the cost of final engineering design, project management, contract preparation, supervision of construction, and other

Owner's costs, consistent with previous experience with similar small hydro and irrigation projects.

- A sum of $75,000 has been added to purchase and install an 800 kW electric boiler and appropriate transformer. This boiler will be used to heat water for the auxiliary loads identified in section 4. These auxiliary loads are presently being serviced by the waste heat of the diesel engines presently generating the electric power for Dawson. The existing installation is equipped with an oil-fired boiler and no additional costs have been allowed for facilities for oil heating of water.
- the cost estimate does not include the cost of preparing a full multidisciplinary feasibility study of the project or the cost of preparing for and obtaining the necessary leases, licences, and permits from the regulatory authorities. The feasibility study would, in this context, consist of obtaining surface and subsurface data at the site and carrying out engineering design to the level of detail required to prepare a contractor-style capital cost estimate. The level of detail would meet the requirements of financial lending institutions to support applications for capital funding for the project, and
- a sum of $65,000 has been added to allow for a fish ladder at the North Fork Spillway.

The unit prices reflect the current condition of the trade unions and the surplus of resources. A significant recovery within the construction industry, particularly within the Yukon Territory, could result in high escalation rates as the construction industry catches up with the economy as a whole.

8.2 Construction Schedule

The construction schedules for the two alternative developments are presented in Figures 31 and 32. The major civil quantities that have the most profound effect on the construction schedule are 3,300 m^3 of concrete and 200 t of sheet piling for the North and South Fork Development. The fact that the work would be carried out at various locations over 37 km would permit much of the work to proceed concurrently.

The project has been costed on the basis of a single season construction program. Execution in one season would be feasible and would require the following:

- an early winter award to ensure all necessary materials will be on site at the end of May. This would be particularly important for materials requiring shop drawings or approvals such as reinforcing steel.
- advance ordering of equipment and materials requiring long fabrication and other lead time such as the turbines, the generators, the transformer, piling and embedded parts.
- award of the civil works to a contractor who has the management, general supervisory and trade supervisory resources to undertake several remote mini projects requiring common resources. For example, the 200 t of sheet piling would be installed at 18 different sites spread along the length of the project.

It is proposed that mobilization would take place in April and May with work on the cofferdam across the Klondike River for the South Fork Diversion Weir starting in May. Concrete placing would begin with the North Fork structures at the beginning of June and by early July, work would be in progress on all structures. The successful tenderer would have to elect whether to double shift the work or to provide more crews to work concurrently. It is expected that penstock installation and the installation of the turbine-generator equipment would proceed concurrently with the civil works. This would be possible because of the different nature of the work involved and the separation of the sites. All work could be completed by the fall in time to commission the units for an on-power date at the beginning of November.

The program of construction would be reviewed on the basis of more complete knowledge of site conditions during the feasibility study stage as part of the work leading to development of more definitive cost estimates.

A time period of 12 months should be allowed for the multidisciplinary feasibility study to ensure that adequate biological data can be assembled. The feasibility study would include topographical surveys of the project sites and subsurface exploration of structure foundations and of potential sources of construction materials. The exploration would probably be limited to a test pit investigation supplemented by geophysical surveys. Sufficient data for final design could be collected during the feasibility study due to the relatively small size of the component structures and because the location of the structures has already been established.

The schedules show an indeterminate period, between the completion of the feasibility study and the start of final design, during which the regulatory hearings would be held.

Five months have been allowed for final design and for the preparation of tender documents.

TABLE 8.1

NORTH FORK DEVELOPMENT
CAPITAL COST ESTIMATE - 2000 kW INSTALLATION

	$000	$000
Civil Works		
North Fork Diversion Dam	58	
North Fork Spillway	735	
North Fork Intake	227	
North Fork Canal	179	
Dempster Highway Crossing	66	
North Fork Canal Spillway	443	
Power Intake	100	
Penstock	620	
Powerplant	41	
Tailrace Weir	44	
Subtotal	2,513	
Contingency 20%	503	
Total		3,016
Mechanical and Electrical Works		
Turbine-Generator Package	1,322	
Switchyard	35	
Subtotal	1,357	
Contingency 15%	204	
Total		1,561
Project Total		4,577
Engineering, Mananagement, Construction Supervision, and Other Owner's Costs		869
Transmission Line*		461
Electric Boiler		75
Allowance For Fish Ladder		65
Total Estimated Cost ($1984) (without AFUDC)		6,047

* See Table 8.5, Transmission Line, Capital Cost Estimate

TABLE 8.2

NORTH AND SOUTH FORK DEVELOPMENT CAPITAL COST ESTIMATE - 2000 kW INSTALLATION

	$000	$000
Civil Works		
North Fork Development (from Table 8.1)	2,511	
South Fork Diversion Weir	1,289	
South Fork Intake	308	
South Fork Canal	530	
Remove 3 Existing Spillways	12	
Lee Creek Spillway	376	
Subtotal	5,026	
Contingency 20%	1,005	
Total		6,031
Mechanical and Electrical Works		
Turbine-Generator Package	1,322	
Switchyard	35	
Subtotal	1,357	
Contingency 15%	204	
Total		1,561
Project Total		7,592
Engineering, Mananagement, Construction Supervision, and other Owner's Costs		1,367
Transmission Line*		461
Electric Boiler		75
Allowance for Fish Ladder		65
Total Estimated Cost ($1984) (without AFUDC)		9,560

* See Table 8.5, Transmission Line, Capital Cost Estimate

TABLE 8.3

NORTH FORK DEVELOPMENT
CAPITAL COST ESTIMATE - 1000 kW INSTALLATION

	$000	$000
Civil Works		
North Fork Diversion Dam	58	
North Fork Spillway	735	
North Fork Intake	227	
North Fork Canal	179	
Dempster Highway Crossing	66	
North Fork Canal Spillway	443	
Power Intake	100	
Penstock	620	
Powerplant	41	
Tailrace Weir	44	
Subtotal	2,513	
Contingency 20%	503	
Total		3,016
Mechanical and Electrical Works		
Turbine-Generator Package	661	
Switchyard	35	
Subtotal	696	
Contingency 15%	104	
Total		800
Project Total		3,816
Engineering, Mananagement, Construction Supervision, and Other Owner's Costs		725
Transmission Line*		461
Electric Boiler		75
Allowance For Fish Ladder		65
Total Estimated Cost ($1984) (without AFUDC)		5,142

* See Table 8.5, Transmission Line, Capital Cost Estimate

TABLE 8.4

ESTIMATED CAPITAL COST ELEMENTS OF THE SOUTH FORK DEVELOPMENT

	$000
Civil Works	
South Fork Diversion Weir	1794
South Fork Intake	429
South Fork Canal	738
Remove 3 Existing Spillways	17
Lee Creek Spillway	522
	3,500

Note: These estimates can be used to assess the approximate cost of possible stages of development intermediate between that of the North Fork Development and the North and South Fork Development assuming that the whole development proceeds at the same time.

TABLE 8.5

TRANSMISSION LINE
CAPITAL COST ESTIMATE - ALL DEVELOPMENTS

	$000
Rebuild existing 3 phase 25 kV line from Dawson to Bear Creek on existing poles (10.1 km).	86.8
Build 8.5 km 3 phase 25 kV line from Bear Creek to Rock Creek using some existing poles.	69.4
Build a new 3 phase 25 kV line from Rock Creek to North Fork Power Plant (approx. 17.2 km).	304.3
TOTAL	460.5

9 - ECONOMIC ANALYSIS

9.1 Methodology and Assumptions

The benefits of redeveloping hydroelectric generation on the Klondike River were assessed by comparing future energy costs with and without the development. A portion of the waste heat from the existing diesel generating station is captured and is presently used for various municipal services. This energy was taken into account in the comparison.

9.1.1 Energy Balance

An energy balance calculation was performed month by month to develop estimates of the amount of fuel which would be needed to supplement hydroelectric energy. The calculation considered the variability of water supply to the hydroelectric plant as expressed by the duration curves for power output shown on Figures 4 to 13 and the following priorities in energy supply:

1. Electricity supply from hydroelectric generation to the fullest extent possible.
2. Supplementary electricity supply by diesel generation as required.
3. Heat recovered from diesel engine cooling to the extent available.
4. Heat provided by electric heaters to the extent that surplus hydroelectric energy is available.
5. Heat by oil-fired heaters as required.

In months with ample water flow, the energy needs can often be fully met by hydroelectric power. Figures 14, 15 and 16 illustrate how diesel and oil heating would supplement hydroelectric energy in January for increasing levels of the total demand.

9.1.2 Development Stages

Three options for development have been analyzed:

1. The North Fork project with 1000 kW of installed capacity;

2. The North Fork project with 2000 kW of installed capacity;
3. The North and South Fork project with 2000 kW of installed capacity.

Options 1 and 2 could be developed in steps as stages of development heading to option 3.

9.1.3 Method of Analysis

The total costs of supplying electricity and heat were calculated month by month and subtracted on an annual basis from the corresponding cost of continuing to meet all electricity and heat requirements through diesel generation. Costs were calculated in terms of revenue requirements known as "Cost of Service" for each development alternative. The Cost of Service in a given year has been calculated as the sum of the costs of:

1. Fuel;
2. Depreciation;
3. Operation and maintenance; and
4. Return on undepreciated investment. (Undepreciated investment is the initial capital cost minus accumulated depreciation)

For the purpose of this comparative analysis, operation and maintenance costs for the hydroelectric station were assumed to be equal to the savings in operation and maintenance costs corresponding to the diesel generation which would be displaced. No capital investment in new or replacement diesel generators was accounted for and no credit for possible redundancy of part of the existing diesel facilities was applied. Each of these factors should result in a degree of conservatism. Operation and maintenance costs should be considered explicitly in future studies.

The annual net savings over 30 years were discounted to a 1984 value employing a discount rate of 13 percent per year.

The following additional assumptions governed the analysis:

1. Depreciation of capital investment on a straight-line basis over 30 years.

2. Rate of return on undepreciated investment, 13 percent per year.

3. Project assumed to be commissioned at the beginning of 1984.

4. Hydroelectric investment costs including costs for transmission facilities, fish ladder, and for an electric boiler assumed incurred at the beginning of 1984.

North Fork Project with 1000 kW capacity	$5,100,000
North Fork Project with 2000 kW capacity	$6,000,000
North and South Fork Project with 2000 kW	$9,600,000.

As the construction period for the hydroelectric development is short (11 months) it was decided to omit the Allowance for Funds Used During Construction (AFUDC) in this preliminary analysis.

5. A general inflation rate assumed to be constant at 5 percent per year. The sensitivity of the results to rates of fuel escalation of 4 percent and 6 percent has also been evaluated.

6. Operation and maintenance costs for the transmission lines are assumed to be $25,000 per year in 1984.

7. The base diesel fuel price in 1984 has been taken to be $0.412 per litre based on 1983 NCPC experience.

8. A fuel rate for the diesel generating sets of 3.35 kW.h per litre of diesel fuel has been assumed based on NCPC experience at the Dawson plant. A fuel rate of 7.37 kW.h per litre was assumed for the oil-fired boilers.

9. Costs of right-of-way and land acquisition and special additional social or environmental impact mitigating measures have not been included.

10. Income taxes have not been included in the calculations.

9.2 Results of Analyses

The results of the analyses are presented in Tables 9.1 through 9.3.

9.2.1 Fuel Savings

Each of the hydroelectric development alternatives would save significant amounts of diesel fuel. In the base year (1984) the 1000 kW and 2000 kW installation would have resulted in savings of 1.9 million litres and 2.4 million litres respectively.

The amount of fuel savings would increase as the demand for electricity grows. Table 9.1 indicates the quantities which would be saved for some of the load conditions analyzed. More complete statistics are tabulated in Appendix B.

9.2.2 Economic Analyses

Redevelopment of hydroelectric power generation would result in net savings in all of the cases which were analyzed. The present values of net benefits which were computed ranged from $434,000 for the largest development coupled with no load growth and a relative decrease in fuel costs to $8,569,947 for the mid-sized development with the highest rates of load growth and fuel cost increases. The results for a selection of the cases analyzed are compared in Table 9.2.

The sensitivity of the predicted benefits to variations in the rate of return on invested capital (and the discount rate) was checked. The effects of changes in these parameters is illustrated in Table 9.2.

TABLE 9.1

DIESEL FUEL REPLACEMENT BY HYDROELECTRIC GENERATION

Hydroelectric Capacity	Fuel Saving in Millions of Litres				
	Growth in Electricity Demand				
	Base Year 1984	Growth @ 1.6% Per Year		Growth @ 70 kW Per Year	
		Accumulation To		Accumulation To	
		15th Year	30th Year	15th Year	30th Year
North Fork Project					
1000 kW	1.9	28	56	29	59
2000 kW	2.4	39	85	44	93
North and South Fork Project					
2000 kW	2.5	41	93	49	106

TABLE 9.2

SUMMARY OF ECONOMIC RESULTS

Hydroelectric Development	Load Growth			Rate of Fuel Escalation Relative to Inflation			Net Present Value of Savings(1)	Breakeven Year(2)	Crossover Year(3)
	Case A No Growth	Case B 1.6% Per Year	Case C 70kW Per Year	1% Less	Same	1% More	$ million		
North Fork Only	X			X			2.4	5	3
1000 kW	X				X		3.1	5	3
	X					X	3.6	4	3
		X		X			2.5	5	3
		X			X		3.2	5	3
		X			X		6.1 (4)	1	1
		X				X	4.0	4	3
			X	X			2.6	5	3
			X		X		3.3	5	3
			X			X	4.2	4	3
North Fork Only	X			X			3.7	2	2
2000 kW	X				X		4.6	2	2
	X					X	5.6	2	2
		X		X			4.9	2	2
		X			X		5.9	2	2
		X			X		10.5 (4)	1	1
		X				X	7.2	2	2
			X	X			6.0	2	2
			X		X		7.2	2	2
			X			X	8.6	2	2
North and South Fork	X			X			.4	25	8
2000 kW	X				X		1.4	19	7
	X					X	2.5	16	7
		X		X			2.1	17	7
		X			X		3.3	15	6
		X			X		8.3 (4)	8	4
		X				X	4.7	13	6
			X	X			3.8	12	6
			X		X		5.2	10	5
			X			X	6.6	10	5

NOTES:

1. This is the sum of the 1984 present worth values of the difference in annual revenue requirements with and without the hydroelectric project over the 30 year period.
2. This is the year when the cumulative present worth of savings becomes greater than zero.
3. This is the year in which the annual revenue requirement for the alternative which includes the hydroelectric project becomes less than the corresponding annual revenue requirements
4. Calculated at 10% discount rate and 10% rate of return.

9.3 Discussion

9.3.1 The Role of Electricity in Overall Energy Supply

The existing diesel powered generating installation yields low grade heat as a byproduct. The analyses have assumed that in future the energy needs now being satisfied by diesel waste heat will continue to be supplied and the costs recovered through the sale of electricity.

Table 9.3 summarizes a breakdown of electrical energy and heat energy supplied in the base year (1984) for the North Fork 2000 kW development. It can be noted that:

- The hydroelectric plant would supply 98 percent of the required electrical energy.
- Surplus electric energy would serve to replace 80 percent of the low grade heat formerly recovered from diesel cooling. The remainder would be supplied by oil.
- Diesel operation would supply 2 percent of the required electrical energy and 11 percent of the required heat energy
- A surplus of 1751 MW.h or 18 percent of the available hydroelectric energy would be unused.

Figures 14, 15, and 16 show a similar breakdown of electrical load as is presented in Table 9.3. The value in Table 9.3 represents the area under the curves in a case very similar to Figure 14. These figures show how the breakdown of load share changes as the total load grows over the life of the plant.

TABLE 9.3

NORTH FORK DEVELOPMENT 2000 kW INSTALLATION

ENERGY BALANCE FOR
THE BASE YEAR

	Electric Energy MW.h	Heat Energy MW.h	Total MW.h
Energy Demand	8236	1834	10070
Energy Supply			
Hydroelectric	8037	1463	9500
Diesel	199	199	398
Oil Heating		172	172
Hydroelectric Energy Available But Not Used			1751

This table illustrates the energy balance calculated for 1984 assuming the North Fork 2000 kW installation to be in operation.

10 - CONCLUSIONS AND RECOMMENDATIONS

Redevelopment of the old Klondike North Fork power site is economic. Redevelopment appears to be economic even if the demand remains at current levels and if diesel fuel prices do not keep up to the rate of general inflation.

The site can provide a power output well in excess of current demand. However, in the driest months of dry years the flow of water is not sufficient to fully satisfy even current requirements. For this reason and for other reasons related to the security of electricity supply, redevelopment of the hydroelectric project requires supplementary diesel generation facilities. In general, however, the 30 year average of fuel consumption is reduced over 80 percent for the base case.

It is recommended that this project be pursued in two steps as follows:

1. Prefeasibility Level Review of Environmental, Socioeconomic, Land Rights and Regulatory Issues

Environmental, socioeconomic, land rights and regulatory issues should be explored on the basis of the overall plan for development which has been visualized in this study. The objective of this review should be to clarify possible conflicts and to define any limitations which may be imposed on the development.

2. Feasibility Study and Regulatory Application

Detailed topographic surveys of existing canals and structures should be made and programs for the exploration of subsurface conditons and identification and assessment of construction materials should be carried out. A full assessment of the opportunity for the use of secondary electric energy to displace oil on an "as available" basis should be made.

Design concepts should be developed taking into account the more complete technical information. Important environmental and other questions should be addressed and the results incorporated in revised preliminary designs for the project elements. Environmental and social impacts of the revised designs should be fully described including land use and regulatory requirements as a component of a multidisciplinary feasibility report. This report should also confirm the economic feasibility of the project and the impact on customer rates.

It is anticipated that a phased development which would approximately match the hydroelectric output with the electricity requirements of the community will prove to be most attractive. Steps in the development might include:

1. development of the North Fork project with an installed capacity of 1000 kW in one unit

2. provision for the enlargement of the development in response to future electricity needs by:

   - addition of a second 1000 kW unit

   - rehabilitation of the South Fork Canal to extend the water gathering system as far as Kerr Creek

   - construction of the South Fork diversion weir and intake to divert Klondike River flows

   - increasing the installed capacity in increments of 1000 kW.

FIGURES

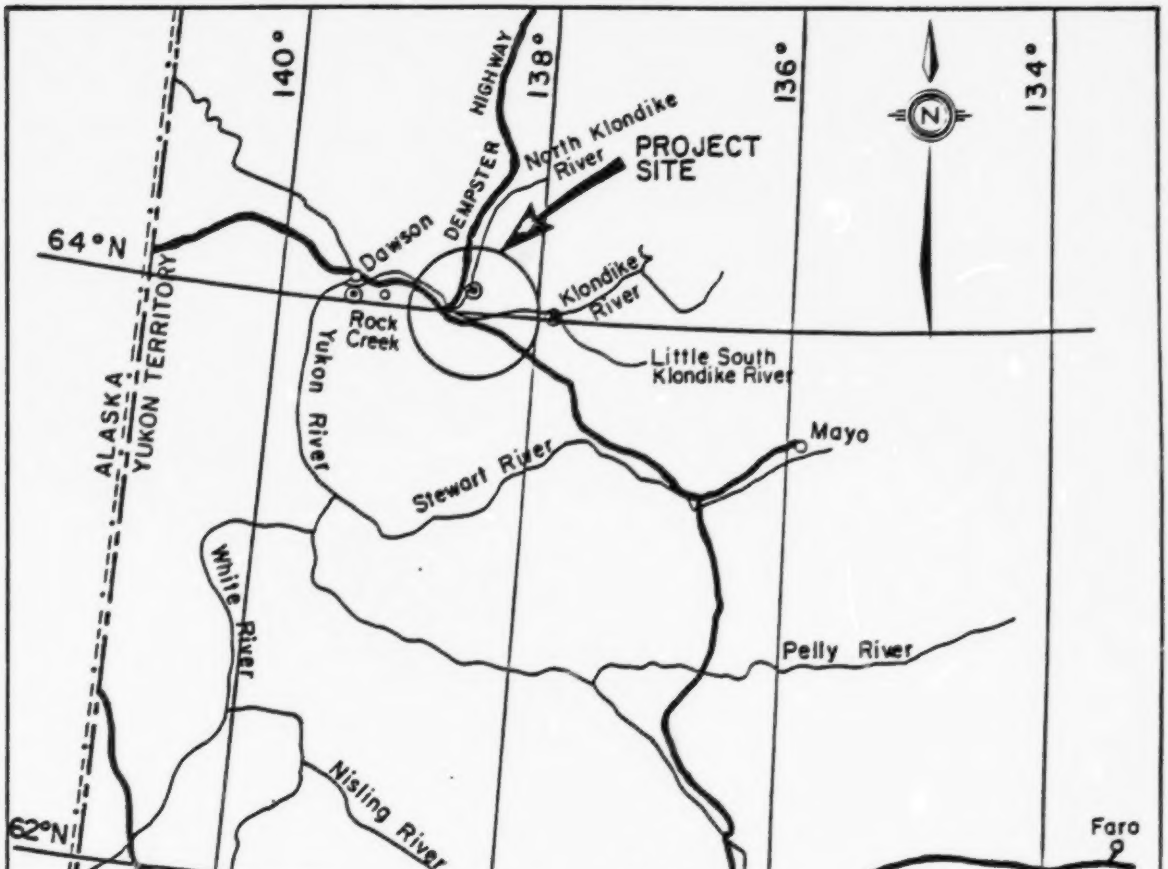
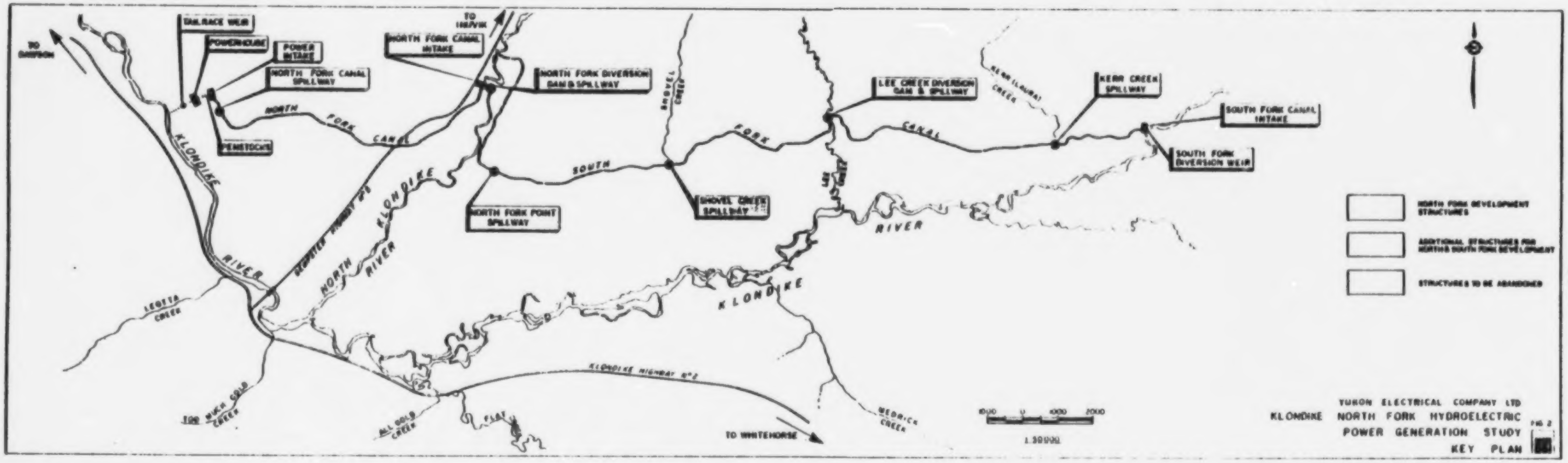

140°
138°
136°
134°
N
64°N
62°N
60°N
PROJECT SITE
North Klondike River
DEMPSTER HIGHWAY
Dawson
Rock Creek
Klondike River
Little South Klondike River
Yukon River
Mayo
Stewart River
White River
Pelly River
Nisling River
Faro
Carmacks
KLONDIKE HIGHWAY
Yukon River
Lac Laberge
Whitehorse
ALASKA HIGHWAY
ALASKA HIGHWAY
Haines Junction
HAINE ROAD
Carcross
KLUANE
NATIONAL
PARK
ALASKA
YUKON TERRITORY
YUKON TERRITORY
BRITISH COLUMBIA
WATER SURVEY OF CANADA GAUGER
HIGHWAY
RIVER

FIG. 1

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
LOCATION PLAN


TO DAWSON
TAILRACE WEIR
POWERHOUSE
POWER INTAKE
NORTH FORK CANAL SPILLWAY
PENSTOCKS
NORTH FORK CANAL
TO INUVIK
NORTH FORK CANAL INTAKE
NORTH FORK DIVERSION DAM & SPILLWAY
NORTH FORK POINT SPILLWAY
SOUTH
SHOVEL CREEK
SHOVEL CREEK SPILLWAY
FORK
LEE CREEK DIVERSION DAM & SPILLWAY
LEE CREEK
CANAL
KERR (LAURA) CREEK
KERR CREEK SPILLWAY
SOUTH FORK CANAL INTAKE
SOUTH FORK DIVERSION WEIR
KLONDIKE RIVER
DEMPSTER HIGHWAY
NORTH KLONDIKE RIVER
KLONDIKE RIVER
LEOTTA CREEK
TOO MUCH GOLD CREEK
ALL GOLD CREEK
FLAT CREEK
KLONDIKE HIGHWAY Nº2
TO WHITEHORSE
HEDRICK CREEK
1000 0 1000 2000
1:30000
NORTH FORK DEVELOPMENT STRUCTURES
ADDITIONAL STRUCTURES FOR NORTH & SOUTH FORK DEVELOPMENT
STRUCTURES TO BE ABANDONED

YUKON ELECTRICAL COMPANY LTD
KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
KEY PLAN

FIG. 2

CITY OF DAWSON ELECTRICAL GENERATION

DERIVED BASE YEAR
(BASED ON NCPC LOAD DATA)

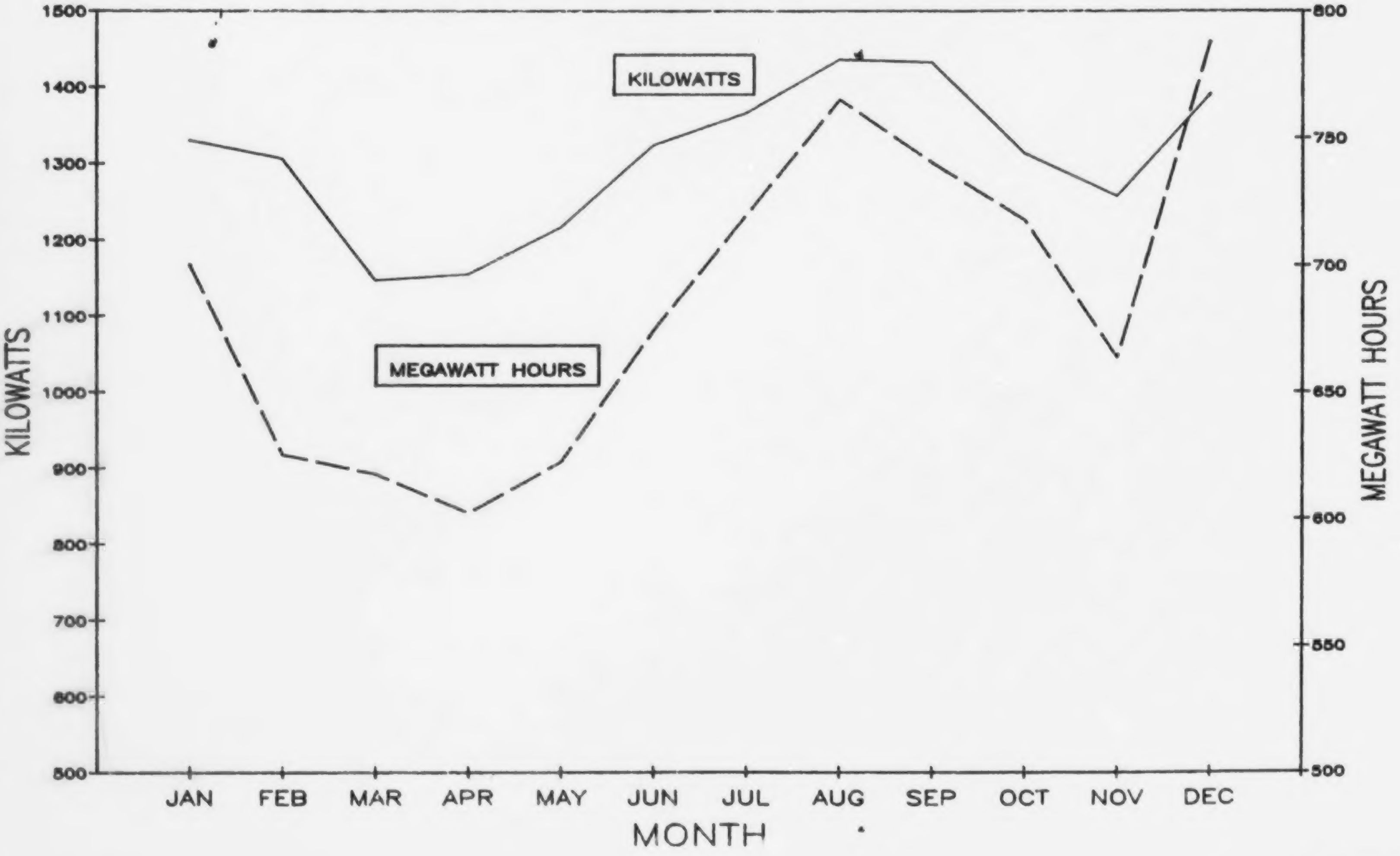
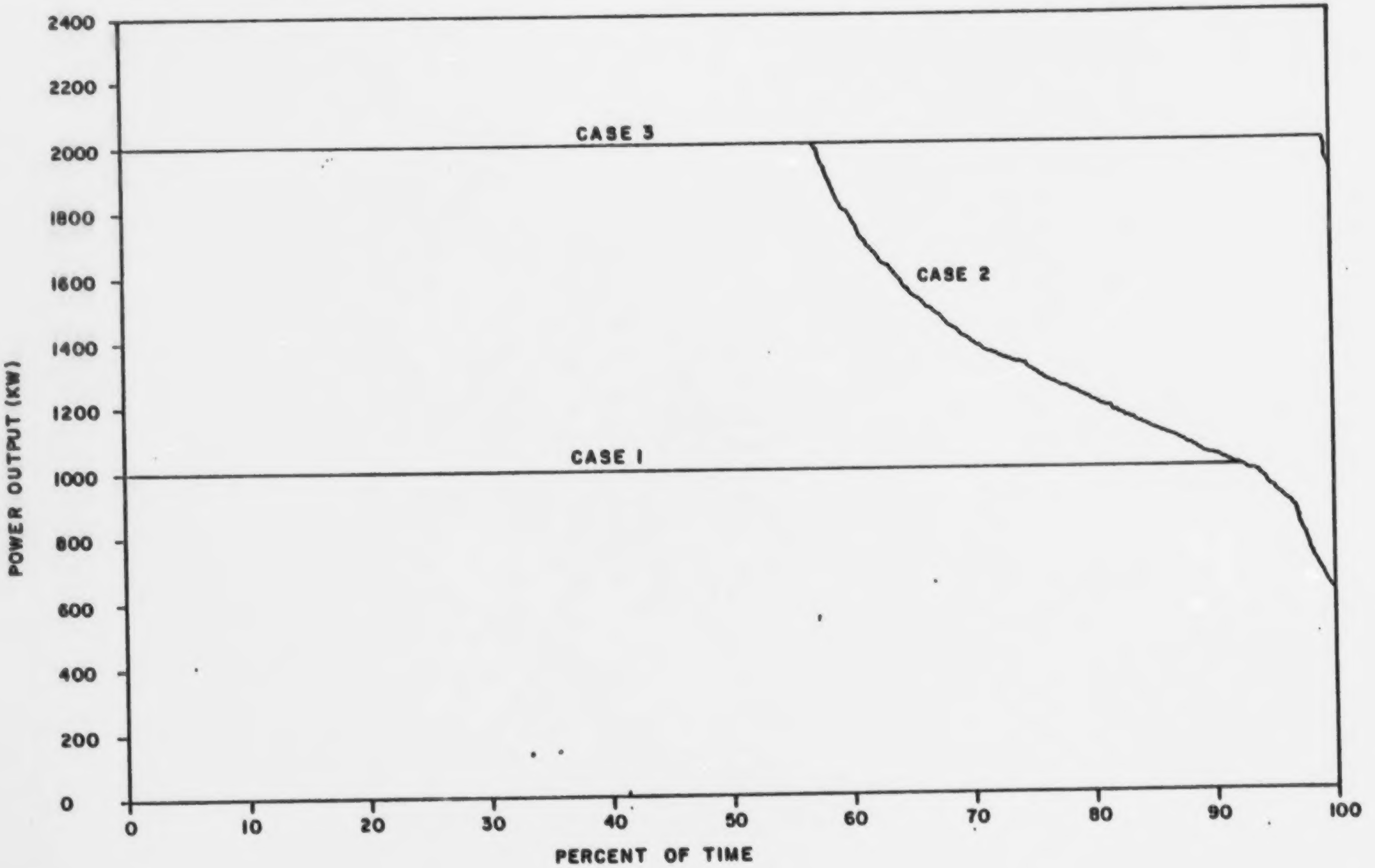


FIGURE 3



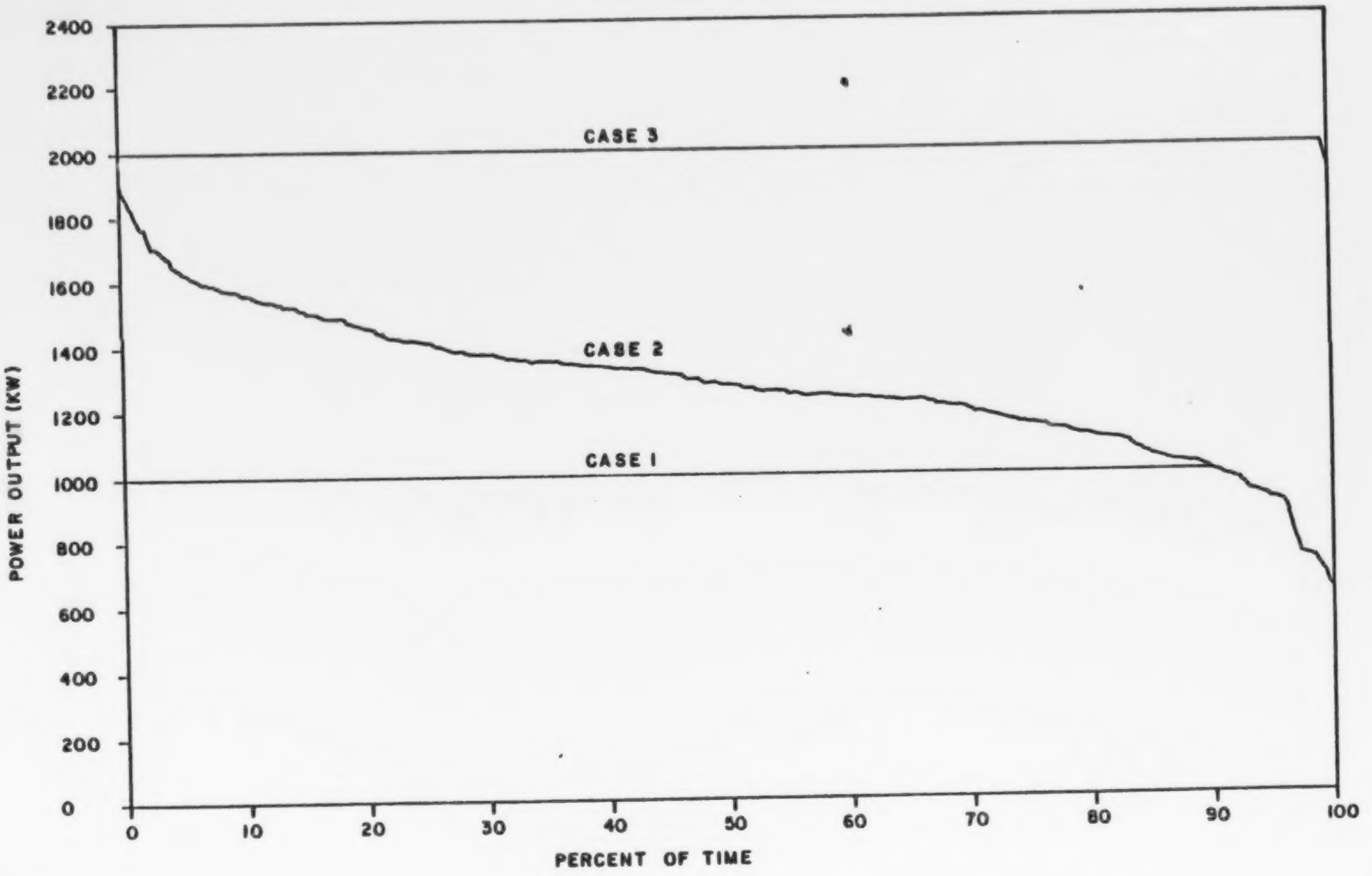
NOTE:

CASE I - 1000 KW, NORTH FORK DEVELOPMENT ONLY
CASE 2 - 2000 KW, NORTH FORK DEVELOPMENT ONLY
CASE 3 - 2000 KW, NORTH AND SOUTH FORK DEVELOPMENT.

FIG. 4

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
DURATION CURVE OF POWER OUTPUT FOR YEAR

ACRES



NOTE:

CASE 1 – 1000 KW, NORTH FORK DEVELOPMENT ONLY

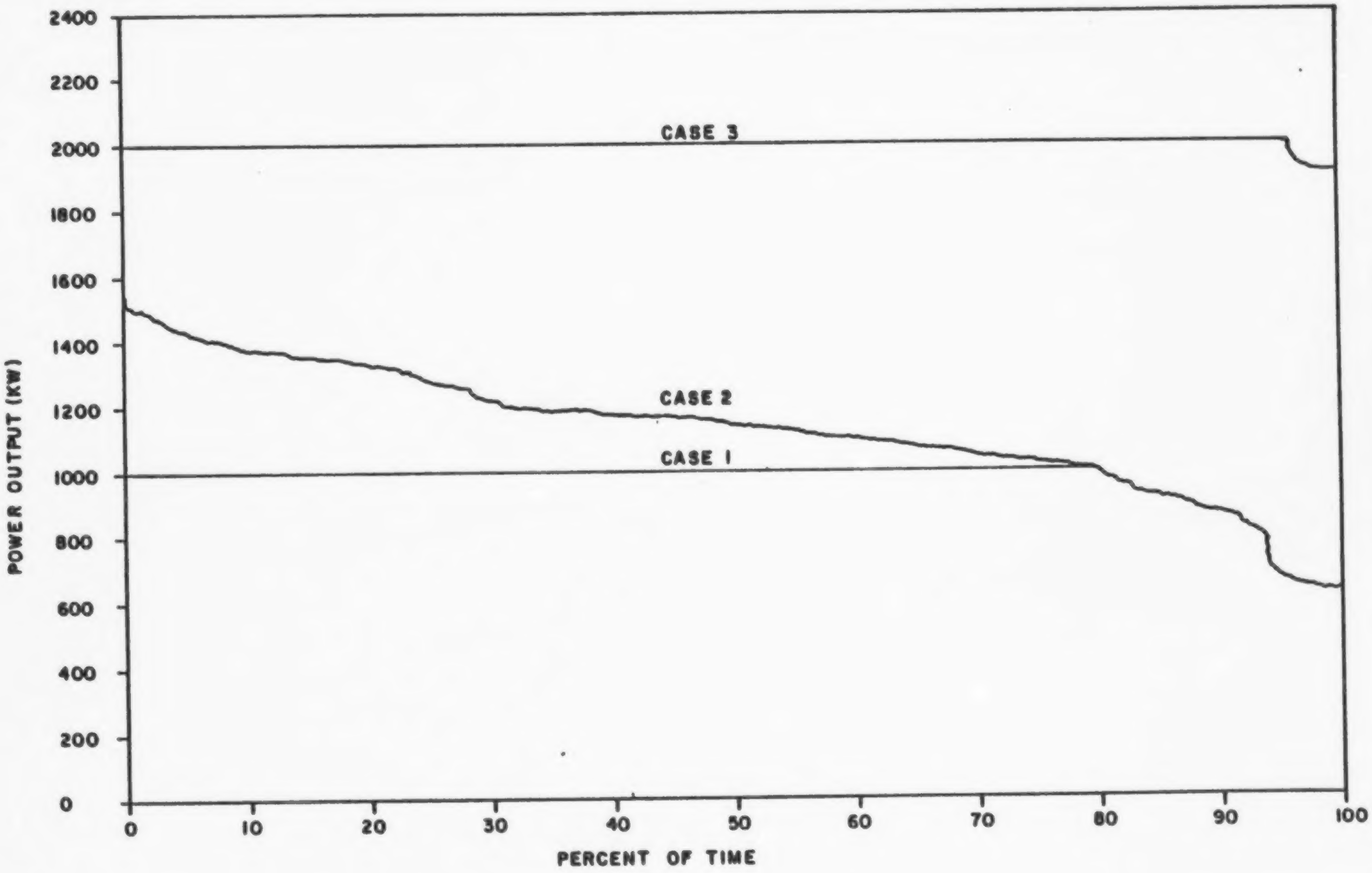
CASE 2 – 2000 KW, NORTH FORK DEVELOPMENT ONLY

CASE 3 – 2000 KW, NORTH AND SOUTH FORK DEVELOPMENT

FIG. 5

ACRES

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
DURATION CURVE OF POWER OUTPUT FOR JANUARY



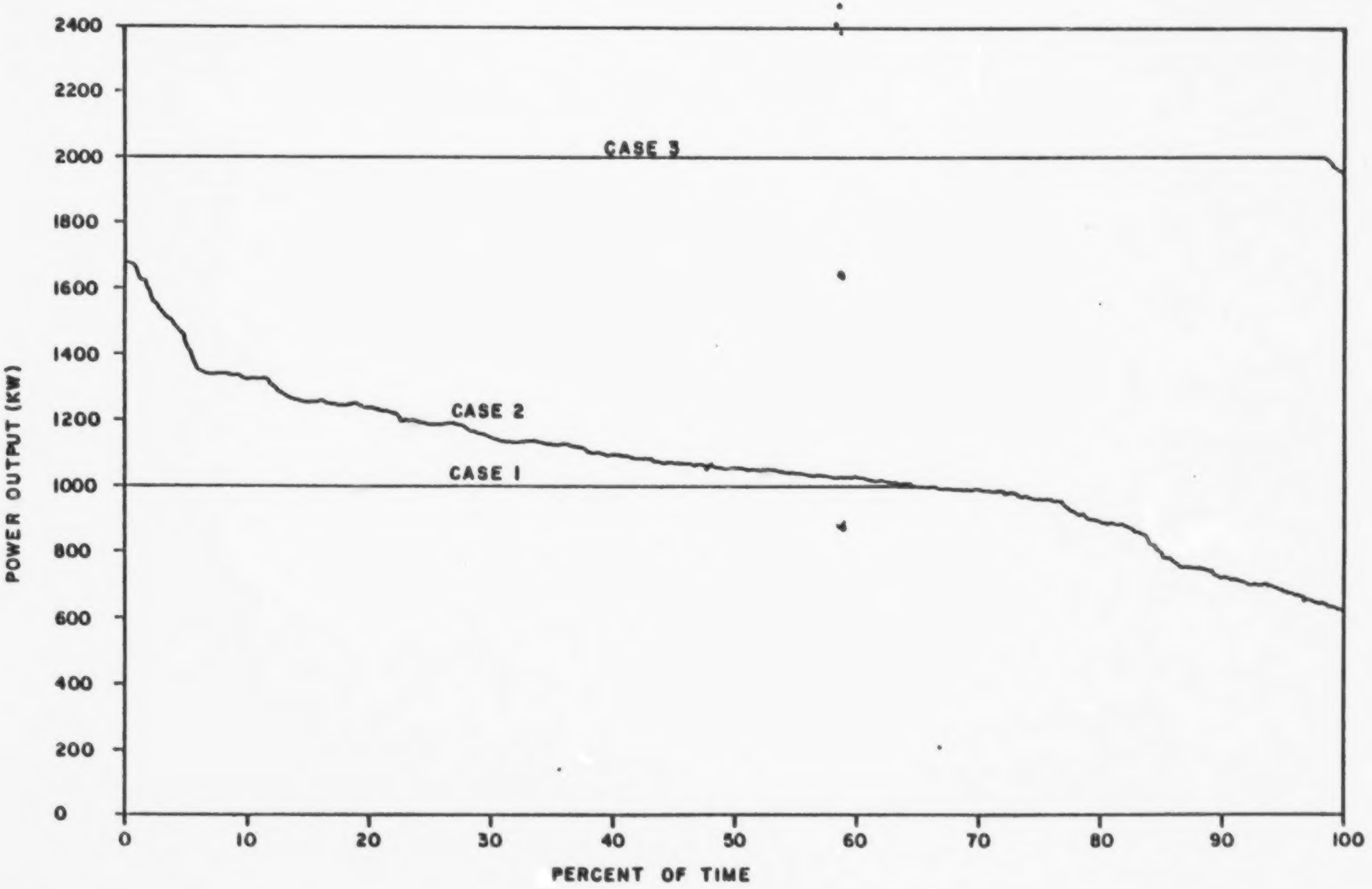
NOTE:

CASE 1 - 1000 KW, NORTH FORK DEVELOPMENT ONLY
CASE 2 - 2000 KW, NORTH FORK DEVELOPMENT ONLY
CASE 3 - 2000 KW, NORTH AND SOUTH FORK DEVELOPMENT

FIG. 6

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
DURATION CURVE OF POWER OUTPUT FOR FEBRUARY

ACRES

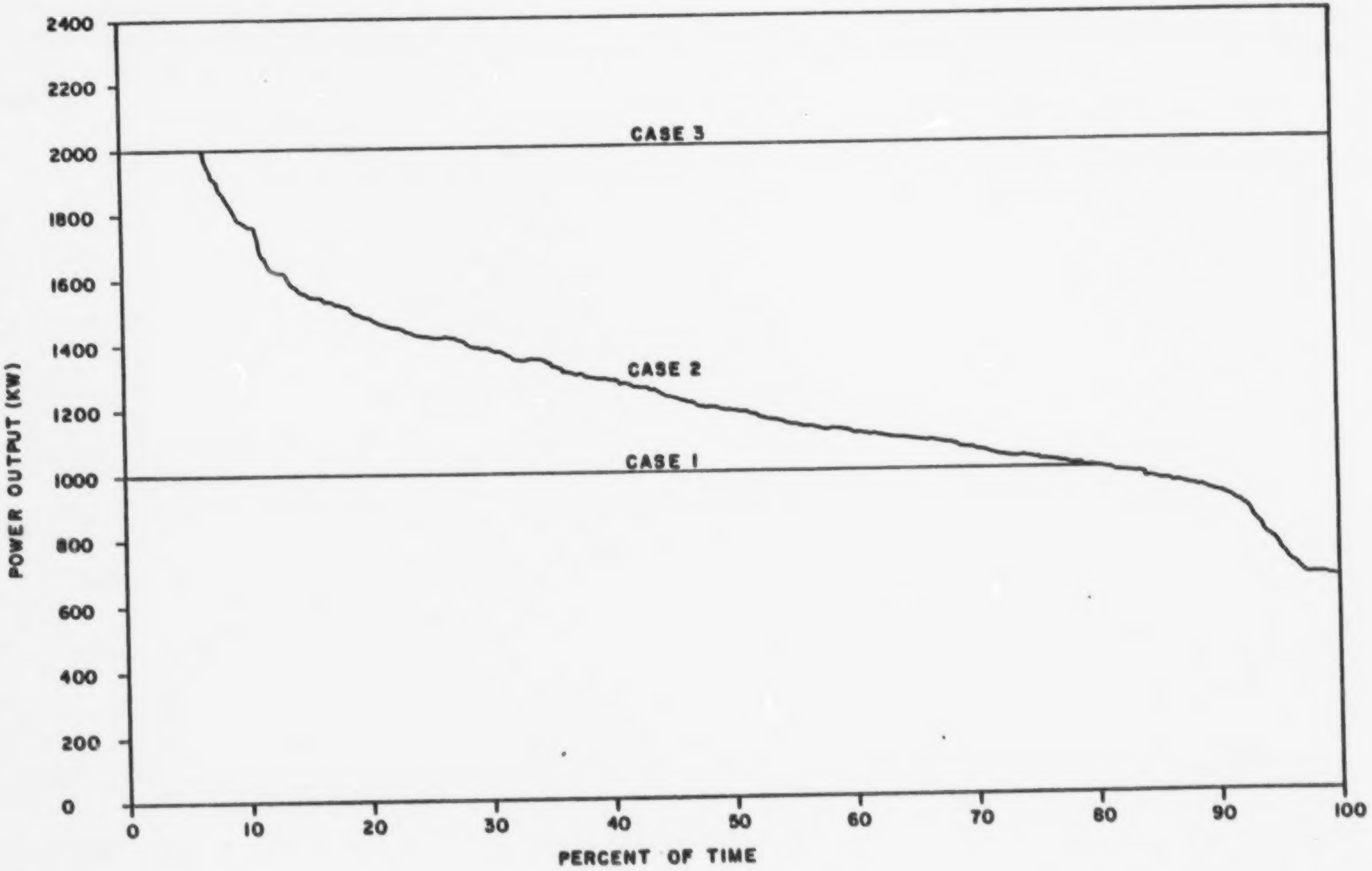


NOTE:

CASE 1 - 1000 KW, NORTH FORK DEVELOPMENT ONLY
CASE 2 - 2000 KW, NORTH FORK DEVELOPMENT ONLY
CASE 3 - 2000 KW, NORTH AND SOUTH FORK DEVELOPMENT

FIG. 7

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
DURATION CURVE OF POWER OUTPUT FOR MARCH



NOTE:

CASE 1 - 1000 KW, NORTH FORK DEVELOPMENT ONLY

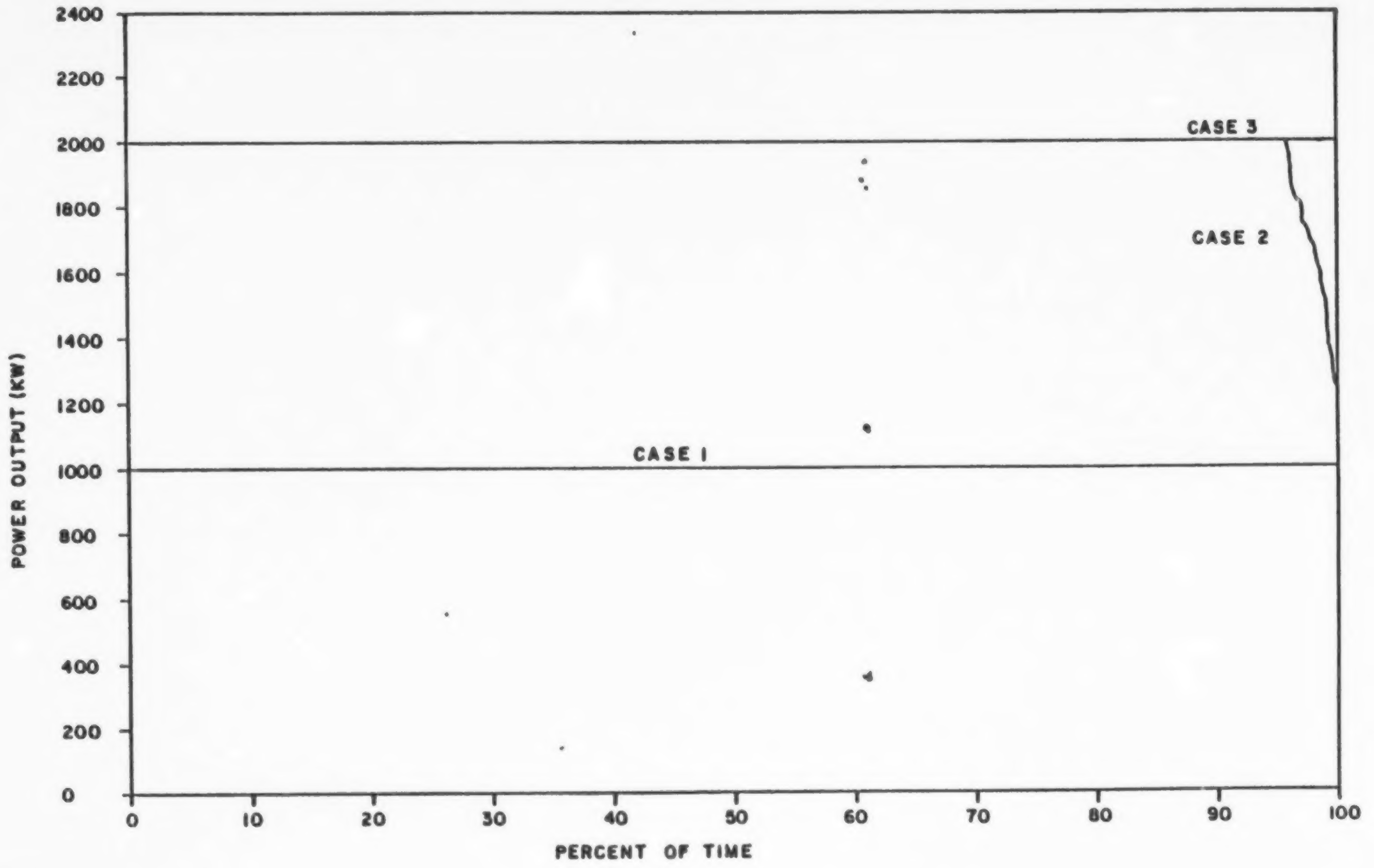
CASE 2 - 2000 KW, NORTH FORK DEVELOPMENT ONLY

CASE 3 - 2000 KW, NORTH AND SOUTH FORK DEVELOPMENT

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
DURATION CURVE OF POWER OUTPUT FOR APRIL

FIG. 8

ACRES



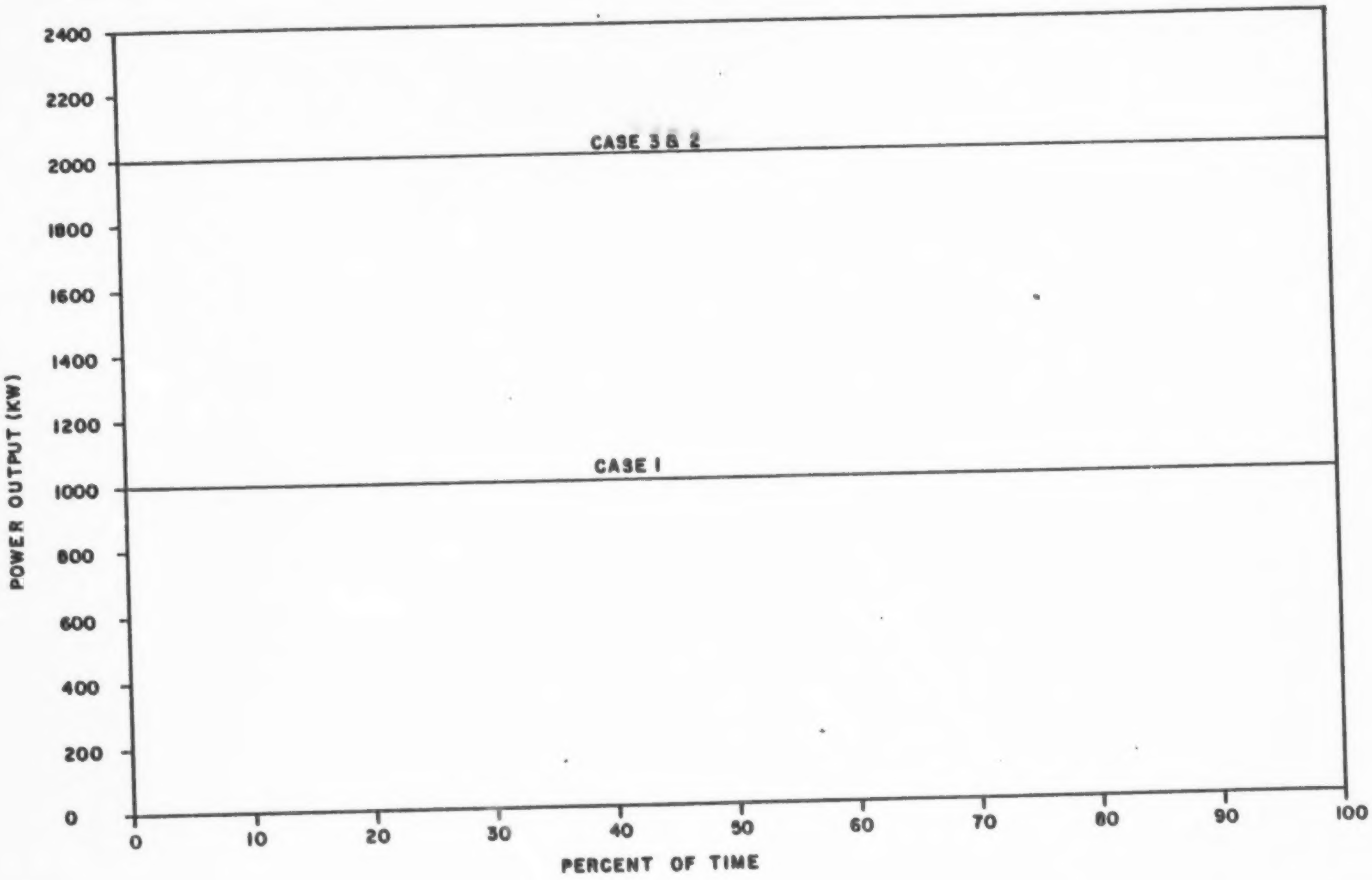
NOTE:

CASE I - 1000 KW, NORTH FORK DEVELOPMENT ONLY
CASE 2 - 2000 KW, NORTH FORK DEVELOPMENT ONLY
CASE 3 - 2000 KW, NORTH AND SOUTH FORK DEVELOPMENT

FIG. 9

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
DURATION CURVE OF POWER OUTPUT FOR MAY

ACRES



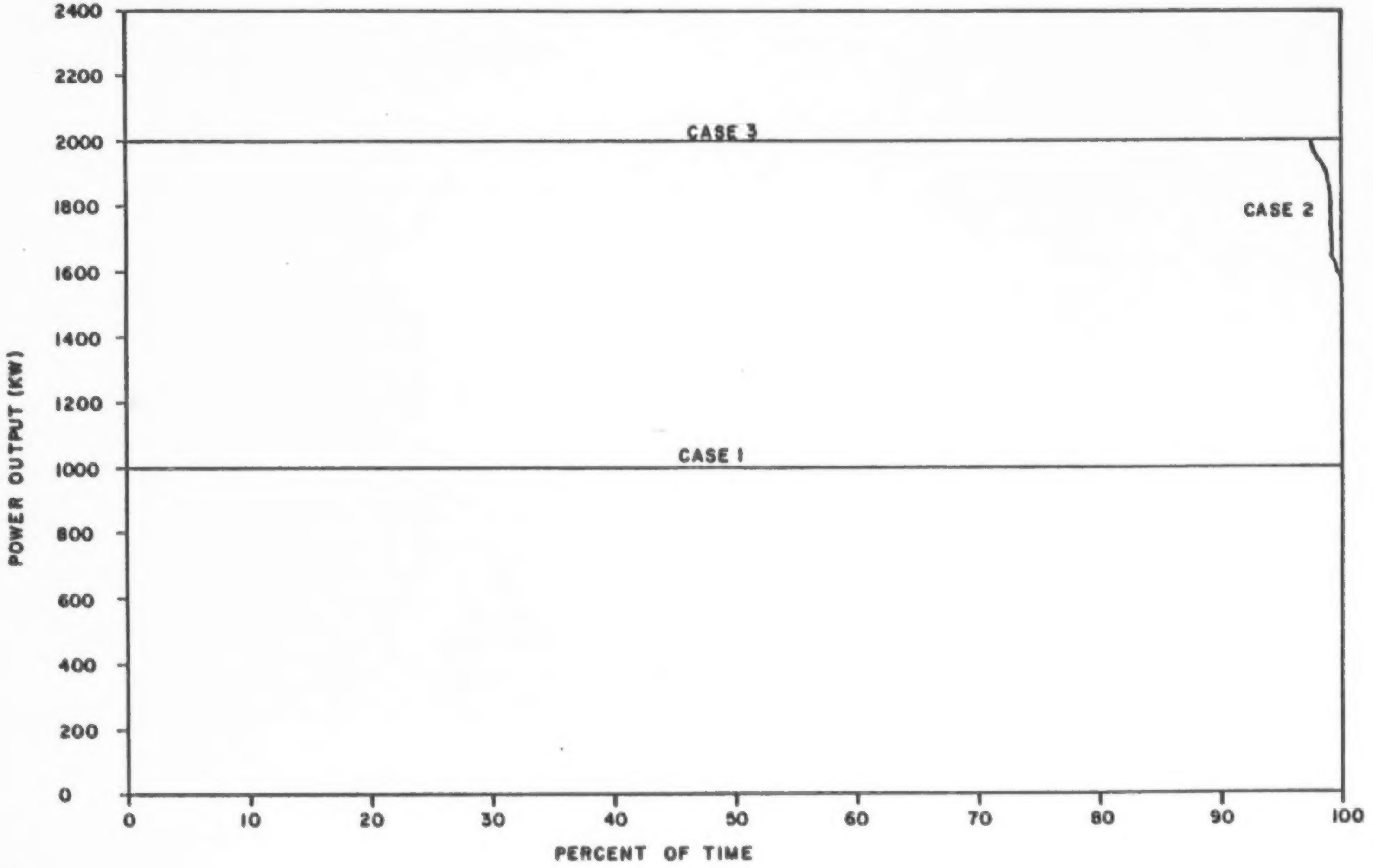
NOTE:

CASE 1 - 1000 KW, NORTH FORK DEVELOPMENT ONLY
CASE 2 - 2000 KW, NORTH FORK DEVELOPMENT ONLY
CASE 3 - 2000 KW, NORTH AND SOUTH FORK DEVELOPMENT

FIG. 10

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
DURATION CURVE OF POWER OUTPUT FOR JUNE-SEPTEMBER

ACRES



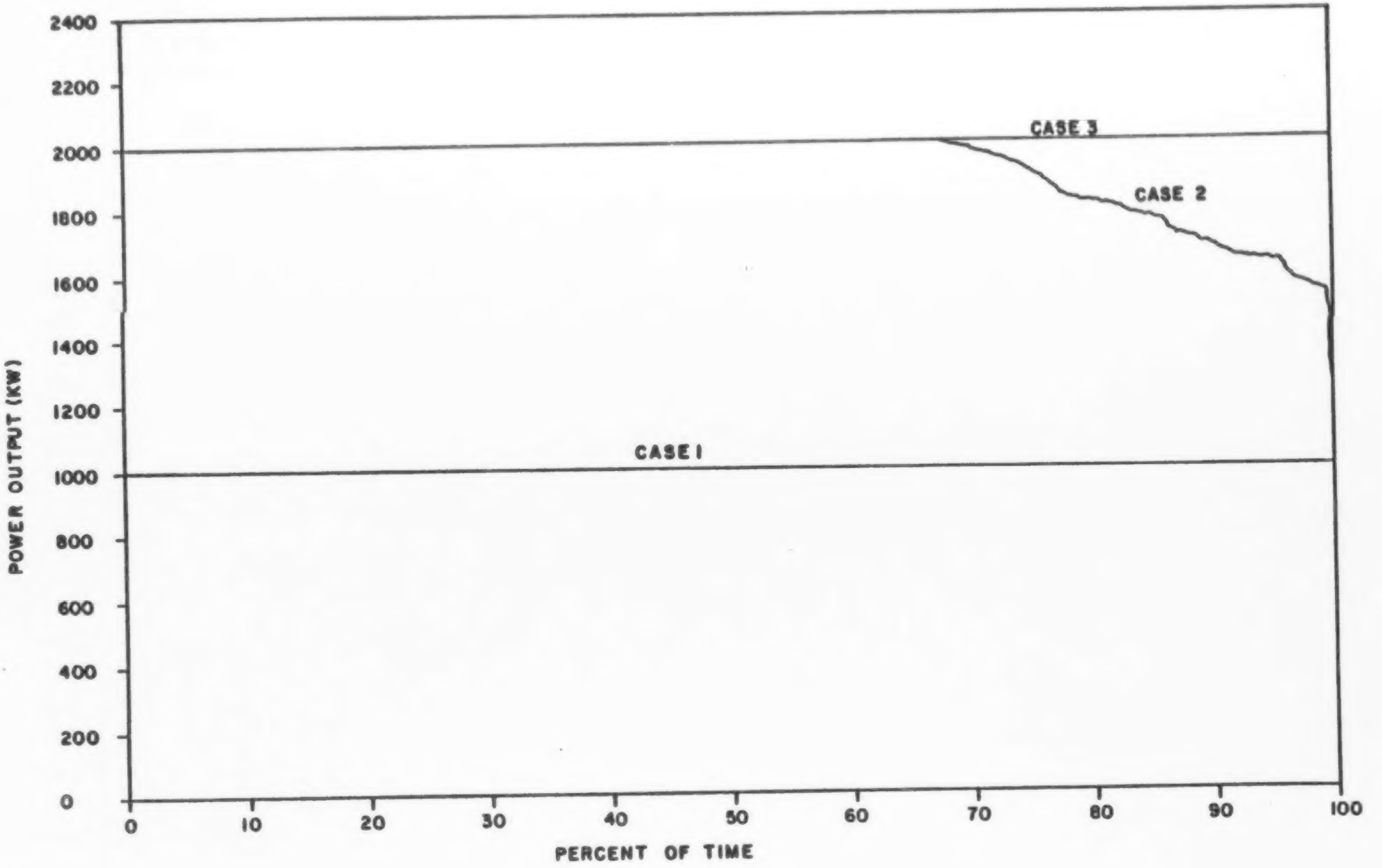
NOTE:

CASE 1 – 1000 KW, NORTH FORK DEVELOPMENT ONLY
CASE 2 – 2000 KW, NORTH FORK DEVELOPMENT ONLY
CASE 3 – 2000 KW, NORTH AND SOUTH FORK DEVELOPMENT

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
DURATION CURVE OF POWER OUTPUT FOR OCTOBER

FIG. 11

ACRES



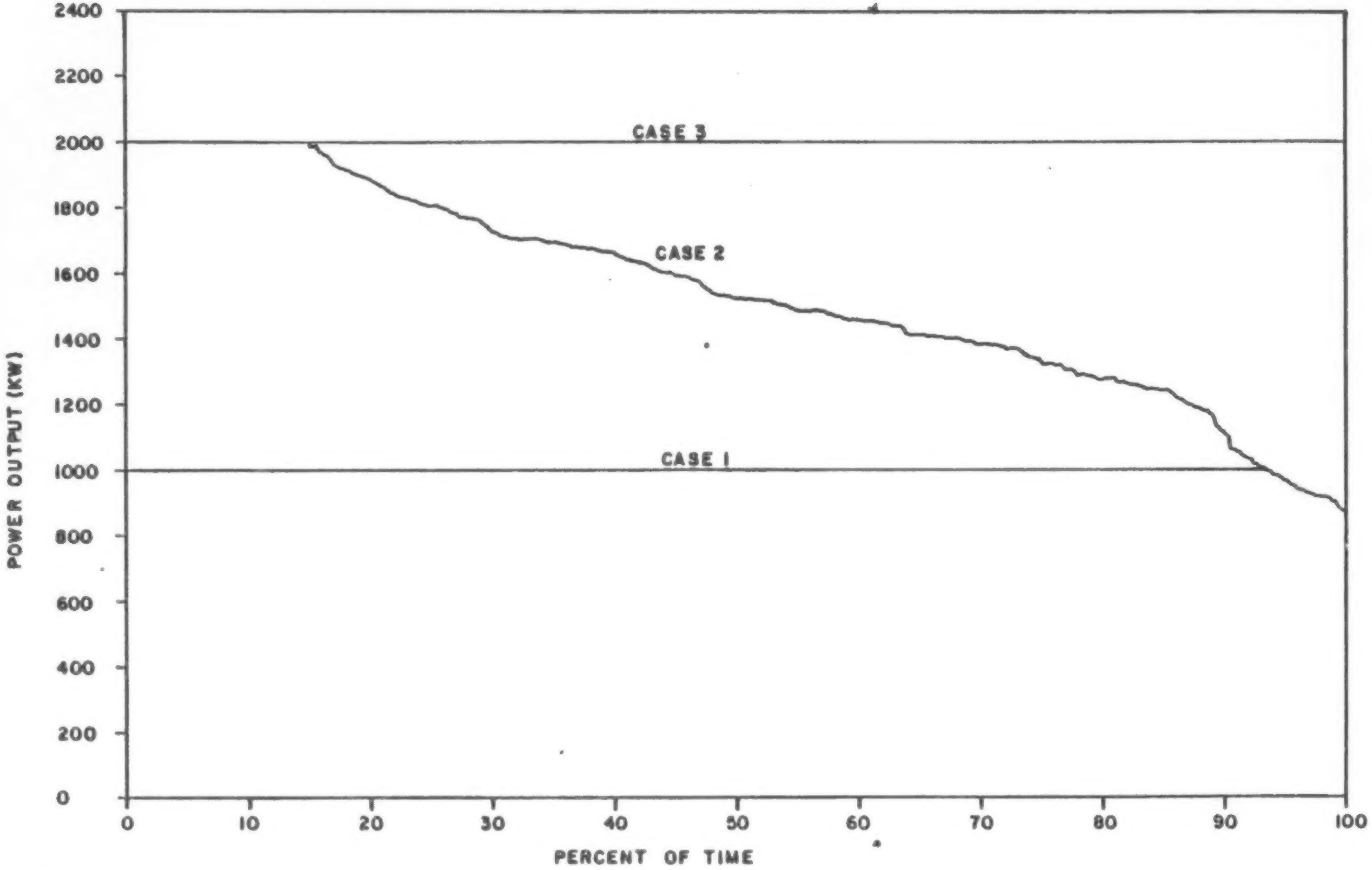
NOTE:

CASE I - 1000 KW, NORTH FORK DEVELOPMENT ONLY
CASE 2 - 2000 KW, NORTH FORK DEVELOPMENT ONLY
CASE 3 - 2000 KW, NORTH AND SOUTH FORK DEVELOPMENT

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
DURATION CURVE OF POWER OUTPUT FOR NOVEMBER

FIG. 12

ACRES



NOTE:

CASE 1 - 1000 KW, NORTH FORK DEVELOPMENT ONLY
CASE 2 - 2000 KW, NORTH FORK DEVELOPMENT ONLY
CASE 3 - 2000 KW, NORTH AND SOUTH FORK DEVELOPMENT

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
DURATION CURVE OF POWER OUTPUT FOR DECEMBER

FIG. 13

ACRES

KLONDIKE HYDRO REDEVELOPMENT STUDY

ENERGY SUPPLY AND DEMAND CURVES JANUARY 1985
2000 kW NORTH FORK CASE B

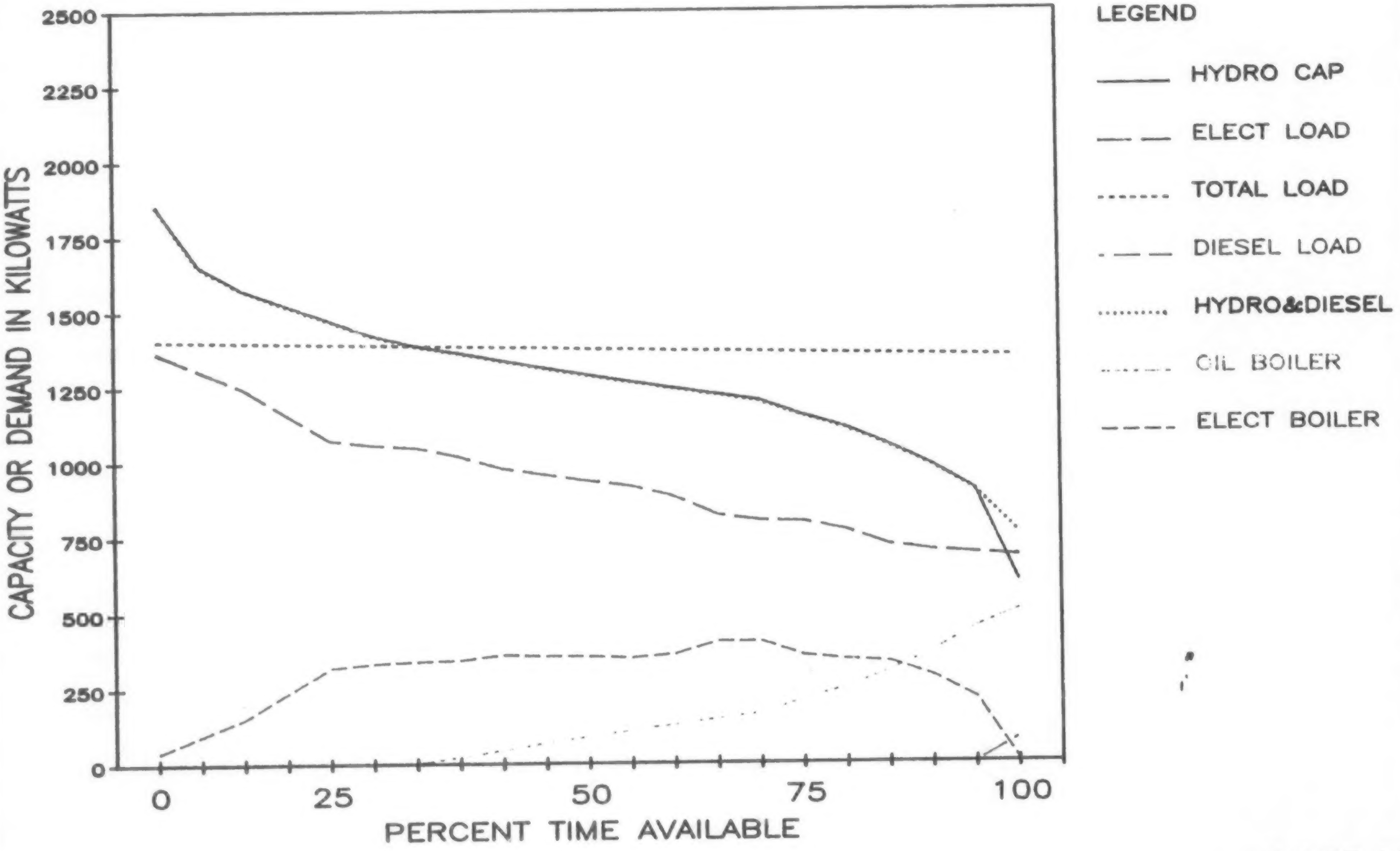


FIGURE 14

KLONDIKE HYDRO REDEVELOPMENT STUDY

ENERGY SUPPLY AND DEMAND CURVES JANUARY 1995
2000 kW NORTH FORK CASE B

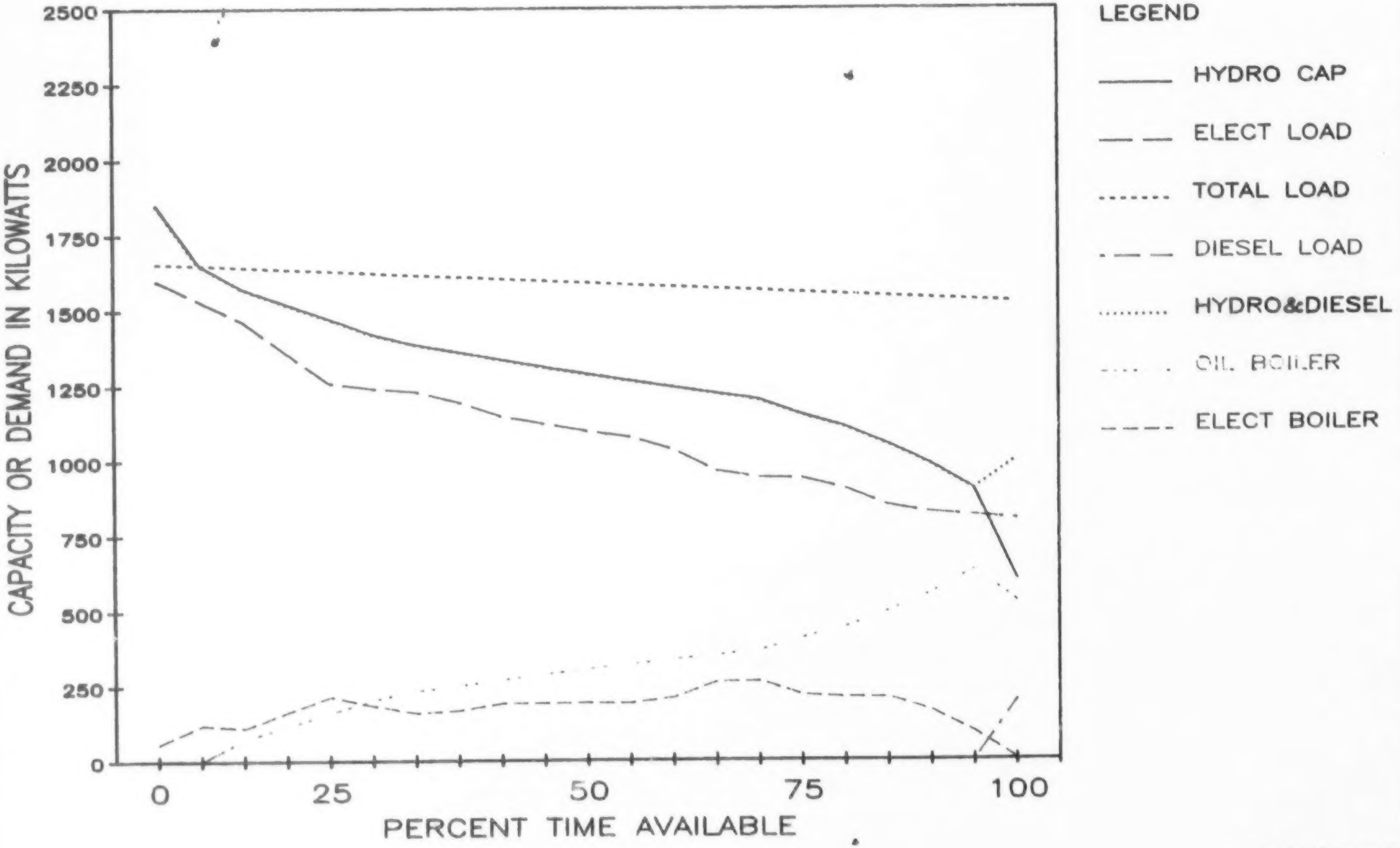


FIGURE 15

KLONDIKE HYDRO REDEVELOPMENT STUDY

ENERGY SUPPLY AND DEMAND CURVES JANUARY 2010
2000 kW NORTH FORK CASE B

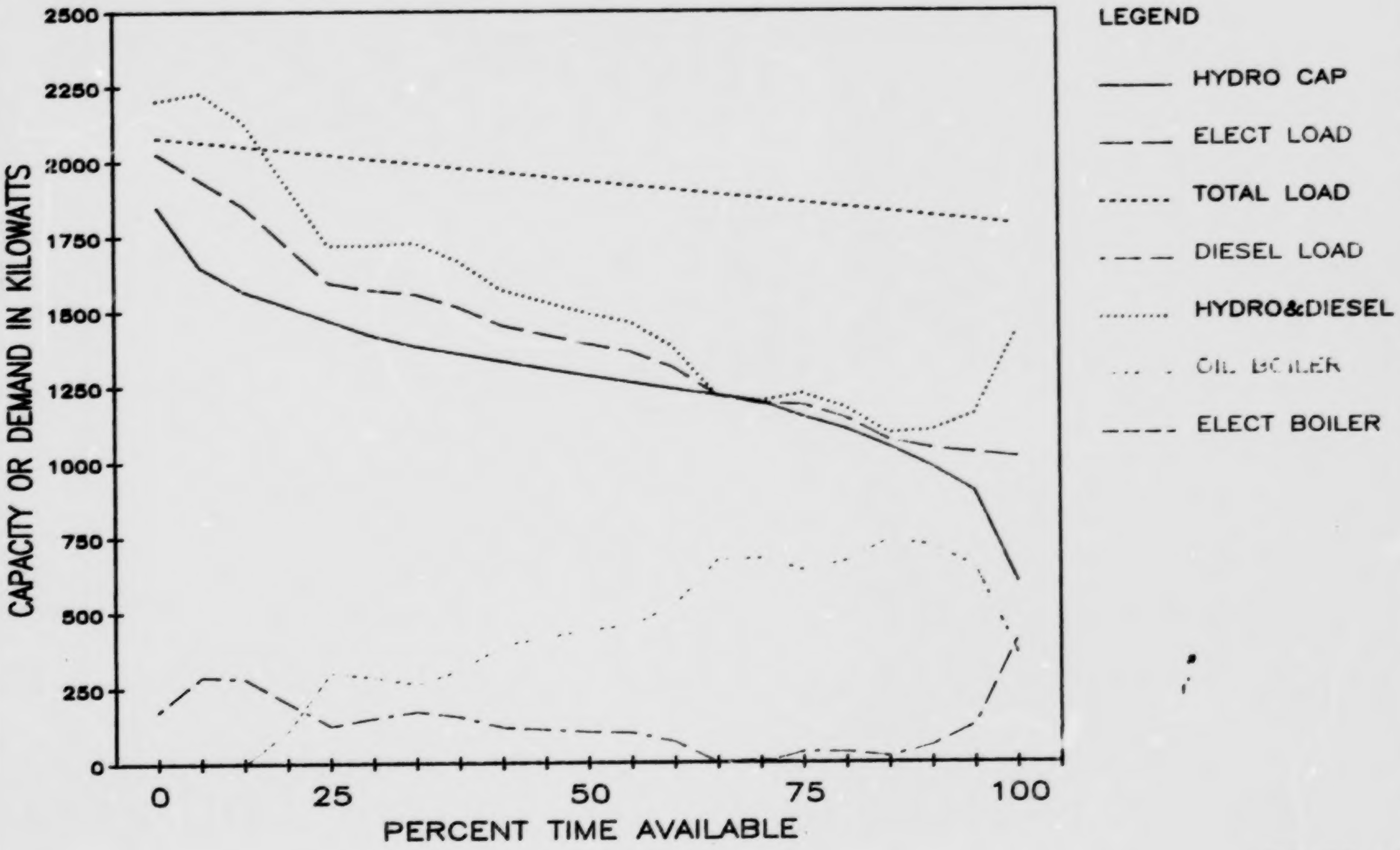


FIGURE 16

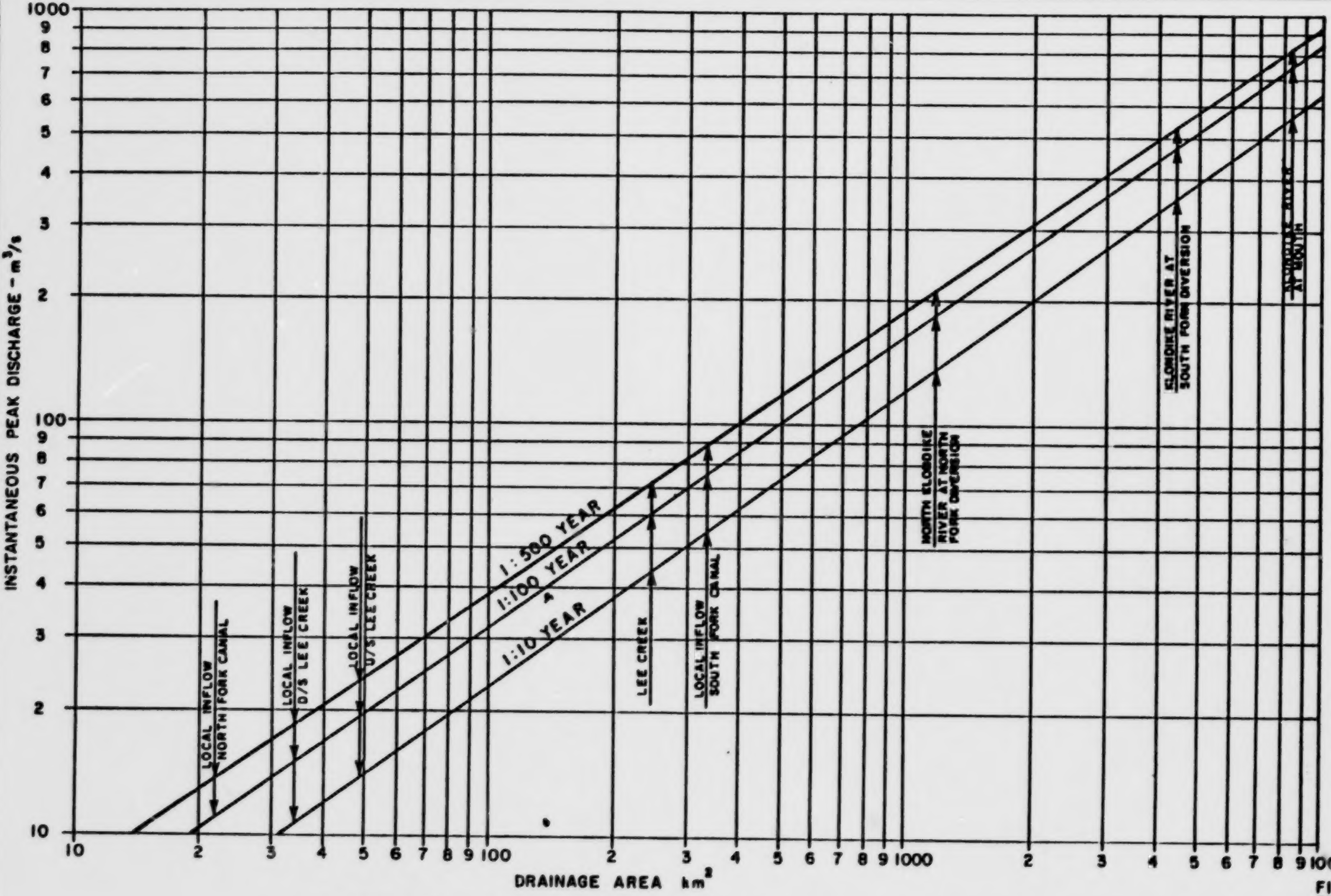
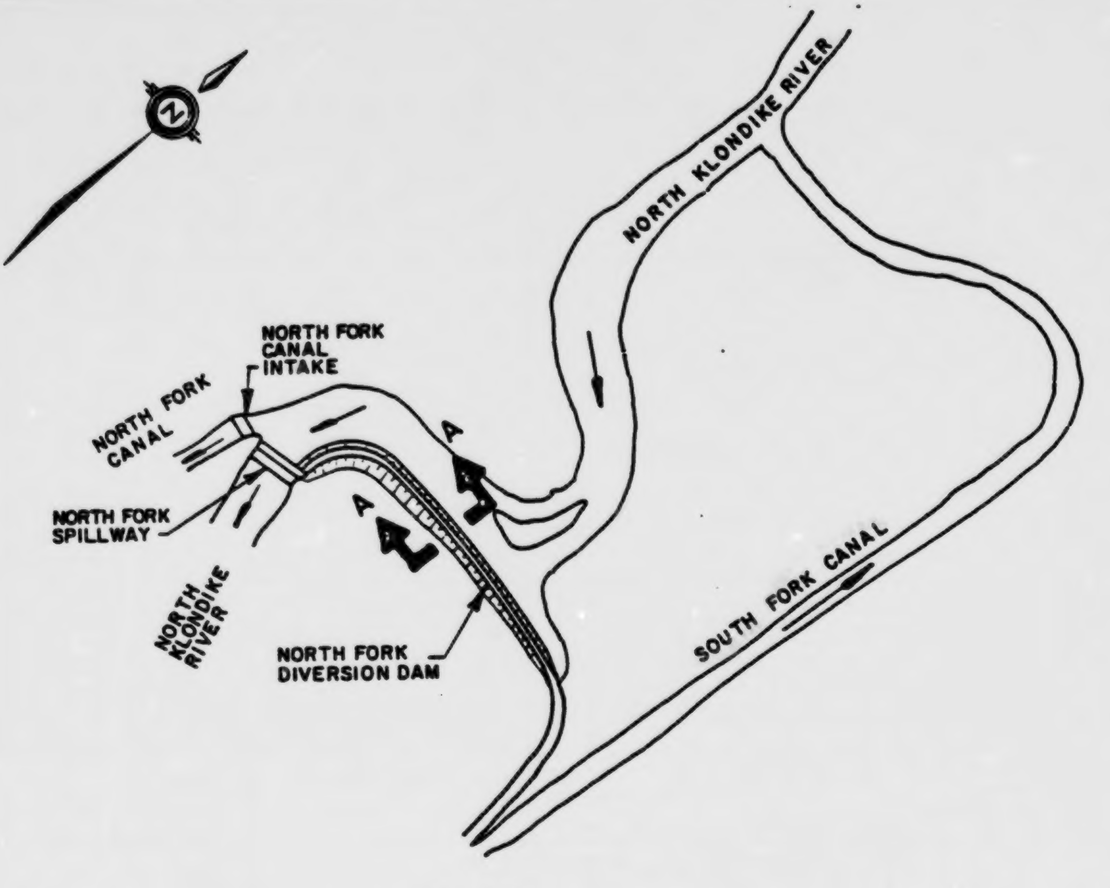
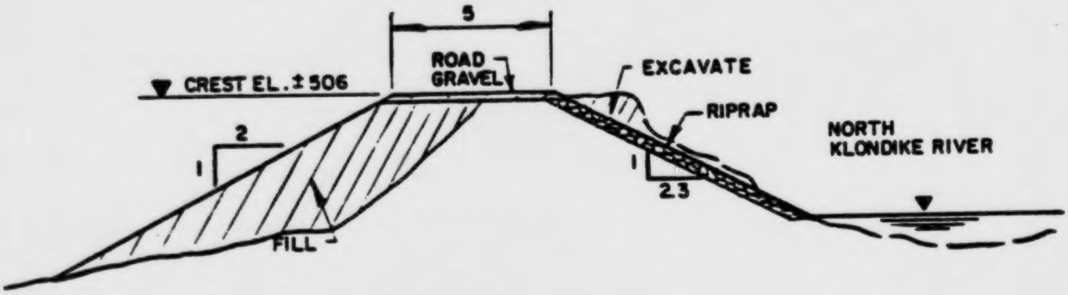


FIG. 17

KLONDIKE NORTH FORK HYDROELECTRIC POWER GENERATION STUDY
REGIONAL FLOOD FREQUENCY FOR KLONDIKE RIVER BASIN


N
NORTH KLONDIKE RIVER
NORTH FORK CANAL INTAKE
NORTH FORK CANAL
A
A
NORTH FORK SPILLWAY
NORTH KLONDIKE RIVER
NORTH FORK DIVERSION DAM
SOUTH FORK CANAL

PLAN


5
ROAD GRAVEL
CREST EL. ± 506
EXCAVATE
RIPRAP
NORTH KLONDIKE RIVER
2
1
1
2.3
FILL

SECTION A-A

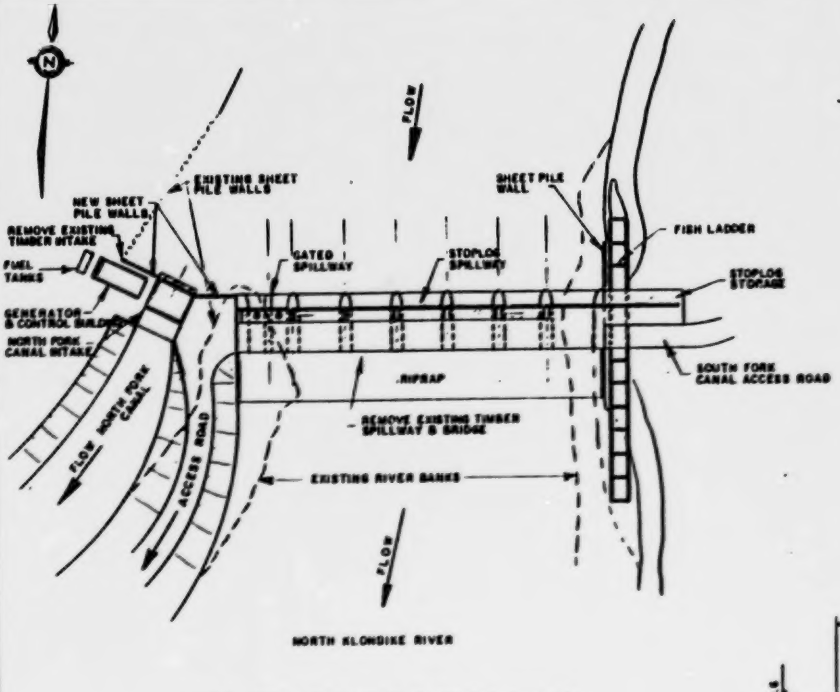
TYPICAL DIVERSION DAM STABILIZATION

SCALE 1:2 (WHERE REQUIRED)

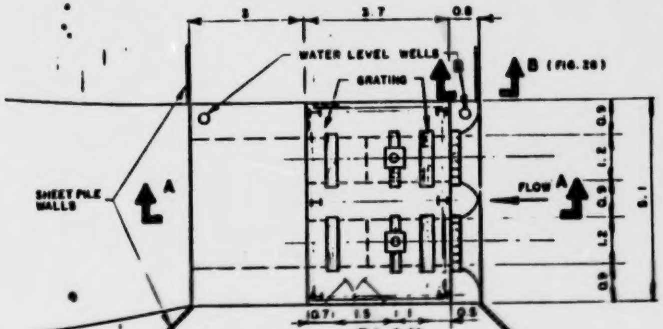
FIG. 18

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
NORTH FORK DIVERSION DAM

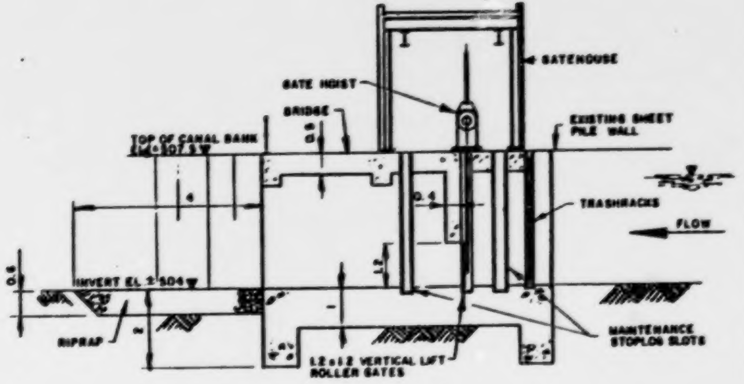
ACRES


N
FLOW
EXISTING SHEET PILE WALLS
NEW SHEET PILE WALLS
REMOVE EXISTING TIMBER INTAKE
FUEL TANKS
GENERATOR & CONTROL BUILDING
NORTH FORK CANAL INTAKE
FLOW NORTH FORK CANAL
ACCESS ROAD
GATED SPILLWAY
STOPLOG SPILLWAY
SHEET PILE WALL
FISH LADDER
STOPLOG STORAGE
SOUTH FORK CANAL ACCESS ROAD
RIPRAP
REMOVE EXISTING TIMBER SPILLWAY & BRIDGE
EXISTING RIVER BANKS
FLOW
NORTH KLONDIKE RIVER

NORTH FORK SPILLWAY & CANAL INTAKE
SCALE 1:500


3
3.7
0.8
WATER LEVEL WELLS
GRATING
B (FIG. 20)
SHEET PILE WALLS
A
FLOW
A
0.9
1.2
0.9
1.2
0.9
5.1
0.7
1.5
1.1
0.8

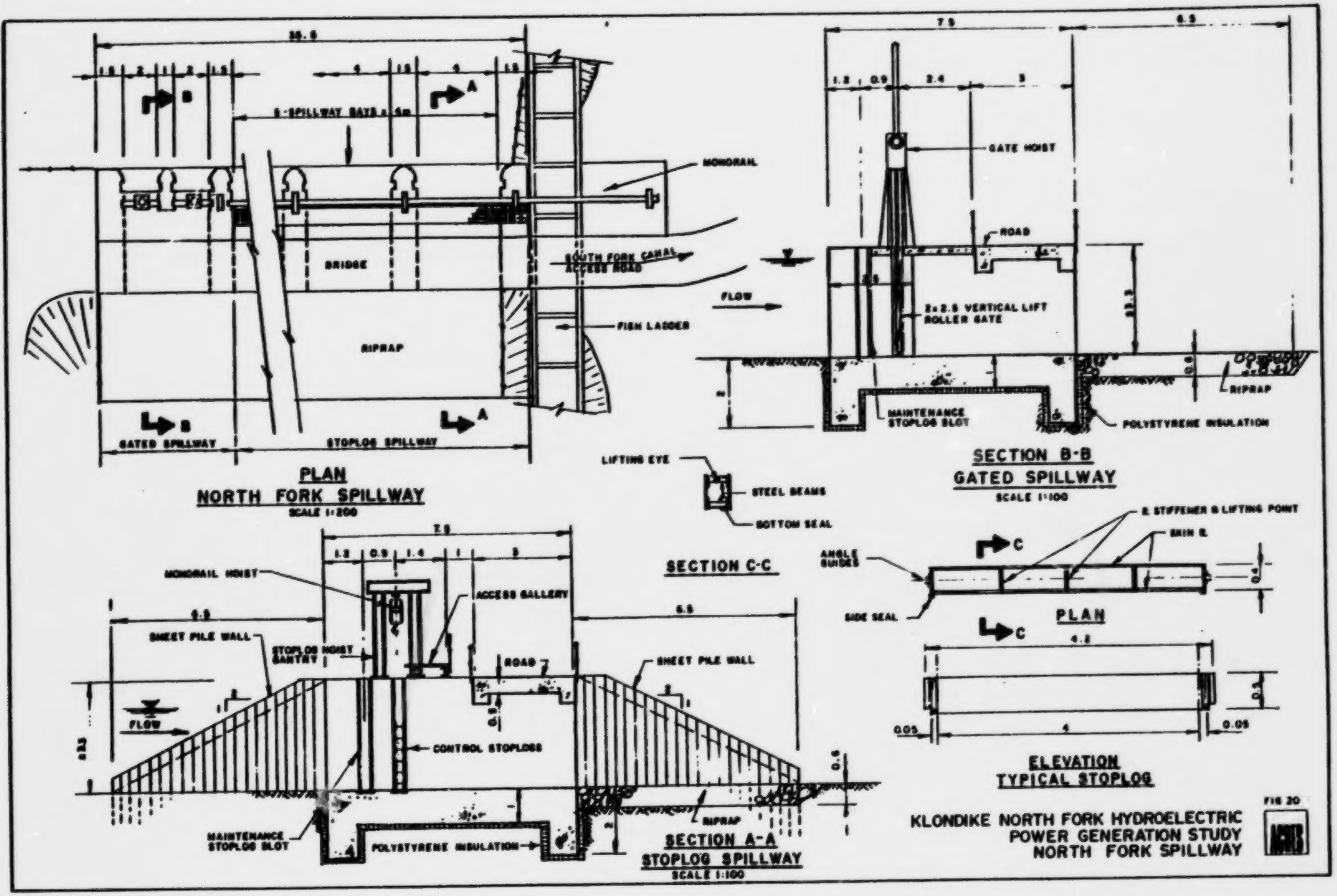
PLAN
NORTH FORK CANAL INTAKE
SCALE 1:100


GATEHOUSE
GATE HOIST
BRIDGE
0.8
TOP OF CANAL BANK EL 2 507.5
EXISTING SHEET PILE WALL
4
0.4
TRASHRACKS
FLOW
1.2
0.6
INVERT EL 2 504
1
2
RIPRAP
MAINTENANCE STOPLOG SLOTS
1.2 x 1.2 VERTICAL LIFT ROLLER GATES

SECTION A-A
SCALE 1:100

FIG. 19

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
NORTH FORK CANAL INTAKE & SPILLWAY



PLAN
NORTH FORK SPILLWAY
SCALE 1:200

SECTION B-B
GATED SPILLWAY
SCALE 1:100

SECTION C-C

PLAN

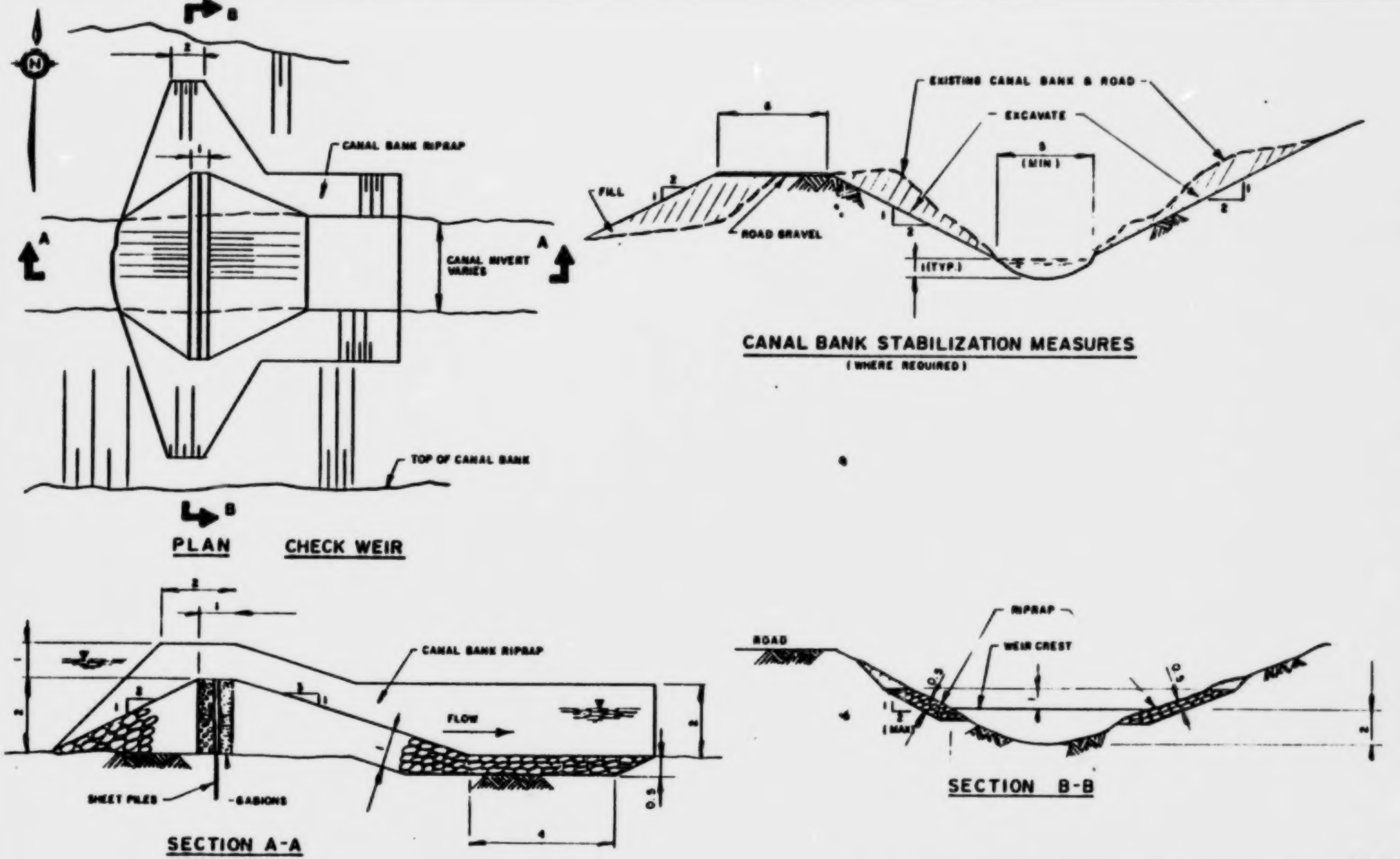
ELEVATION
TYPICAL STOPLOG

SECTION A-A
STOPLOG SPILLWAY
SCALE 1:100

FIG 20

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
NORTH FORK SPILLWAY

30.6
1.5
2
1
2
1.5
4
1.5
4
1.5
5-SPILLWAY BAYS x 4m
B
A
MONORAIL
BRIDGE
SOUTH FORK CANAL ACCESS ROAD
FLOW
FISH LADDER
RIPRAP
GATED SPILLWAY
STOPLOG SPILLWAY
7.5
6.5
1.2
0.9
2.4
3
GATE HOIST
ROAD
2x2.5 VERTICAL LIFT ROLLER GATE
MAINTENANCE STOPLOG SLOT
POLYSTYRENE INSULATION
RIPRAP
0.6
LIFTING EYE
STEEL BEAMS
BOTTOM SEAL
Ɛ STIFFENER & LIFTING POINT
SKIN Ɛ
ANGLE GUIDES
SIDE SEAL
C
0.4
4.2
4
0.5
0.05
0.05
7.5
1.2
0.9
1.4
1
3
MONORAIL HOIST
ACCESS GALLERY
6.5
6.5
SHEET PILE WALL
STOPLOG HOIST GANTRY
ROAD
SHEET PILE WALL
2
1
CONTROL STOPLOGS
MAINTENANCE STOPLOG SLOT
POLYSTYRENE INSULATION
RIPRAP
0.6
2

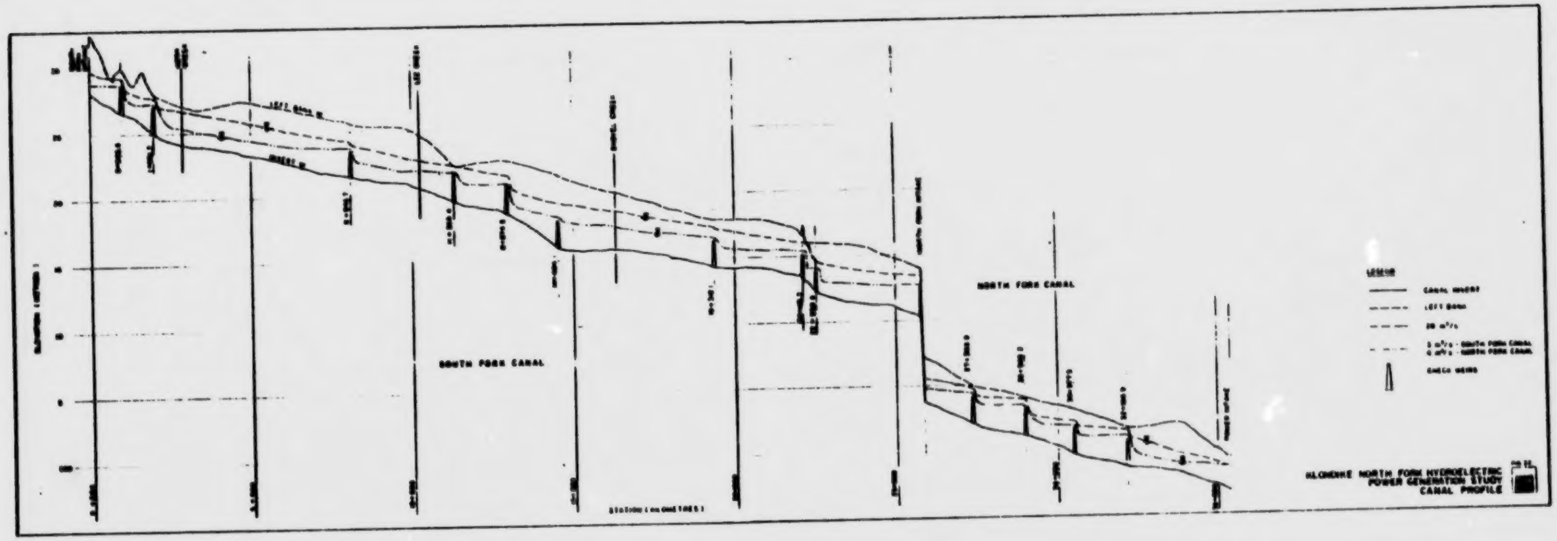

N
B
A
2
1
CANAL BANK RIPRAP
CANAL INVERT VARIES
TOP OF CANAL BANK
PLAN
CHECK WEIR
FILL
ROAD GRAVEL
6
EXISTING CANAL BANK & ROAD
EXCAVATE
5
(MIN)
1(TYP.)
CANAL BANK STABILIZATION MEASURES
(WHERE REQUIRED)
SHEET PILES
GABIONS
FLOW
4
0.5
SECTION A-A
SCALE 1:100
ROAD
RIPRAP
WEIR CREST
0.3
(MAX)
SECTION B-B

NOTE:
SCALE 1:200 UNLESS OTHERWISE NOTED

FIG 21

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
CANAL REHABILITATION & CHECK WEIR

ACRES


LEFT BANK
INVERT
SOUTH FORK CANAL
NORTH FORK CANAL
STATION (KILOMETRES)
LEGEND
CANAL INVERT
LEFT BANK
20 m³/s
3 m³/s - SOUTH FORK CANAL
6 m³/s - NORTH FORK CANAL
CHECK WEIRS
KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
CANAL PROFILE

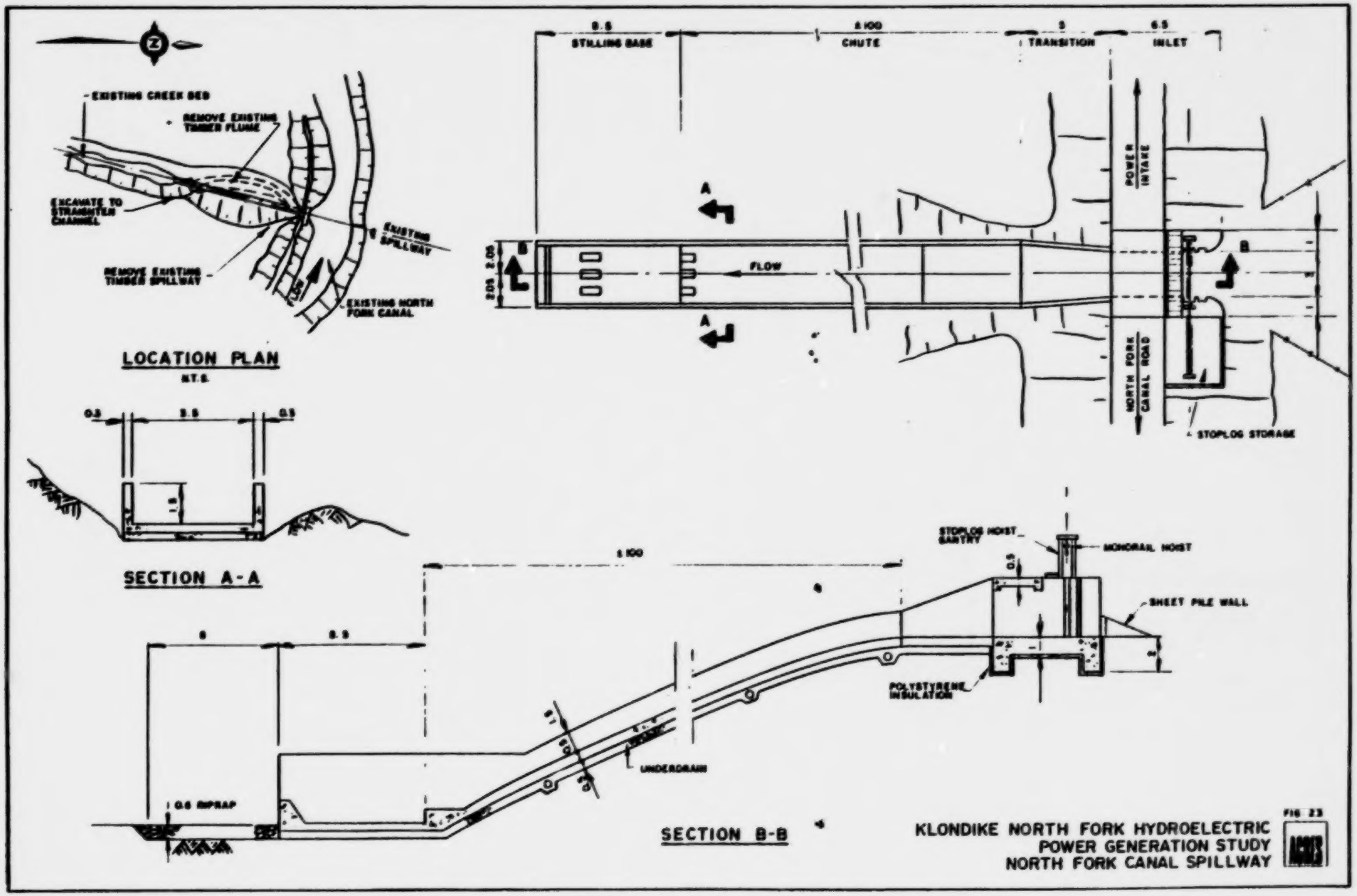

N
EXISTING CREEK BED
REMOVE EXISTING TIMBER FLUME
EXCAVATE TO STRAIGHTEN CHANNEL
EXISTING SPILLWAY
REMOVE EXISTING TIMBER SPILLWAY
EXISTING NORTH FORK CANAL
LOCATION PLAN
N.T.S.
8.5
STILLING BASIN
±100
CHUTE
3
TRANSITION
6.5
INLET
POWER INTAKE
NORTH FORK CANAL ROAD
A
A
B
B
FLOW
2.05
2.05
STOPLOG STORAGE
0.3
3.5
0.3
1.5
SECTION A-A
±100
8
8.5
6
0.5
3
1.1
0.5
0.3
0.6 RIPRAP
STOPLOG HOIST GANTRY
MONORAIL HOIST
SHEET PILE WALL
POLYSTYRENE INSULATION
UNDERDRAIN
SECTION B-B
ACRES

FIG 23

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
NORTH FORK CANAL SPILLWAY

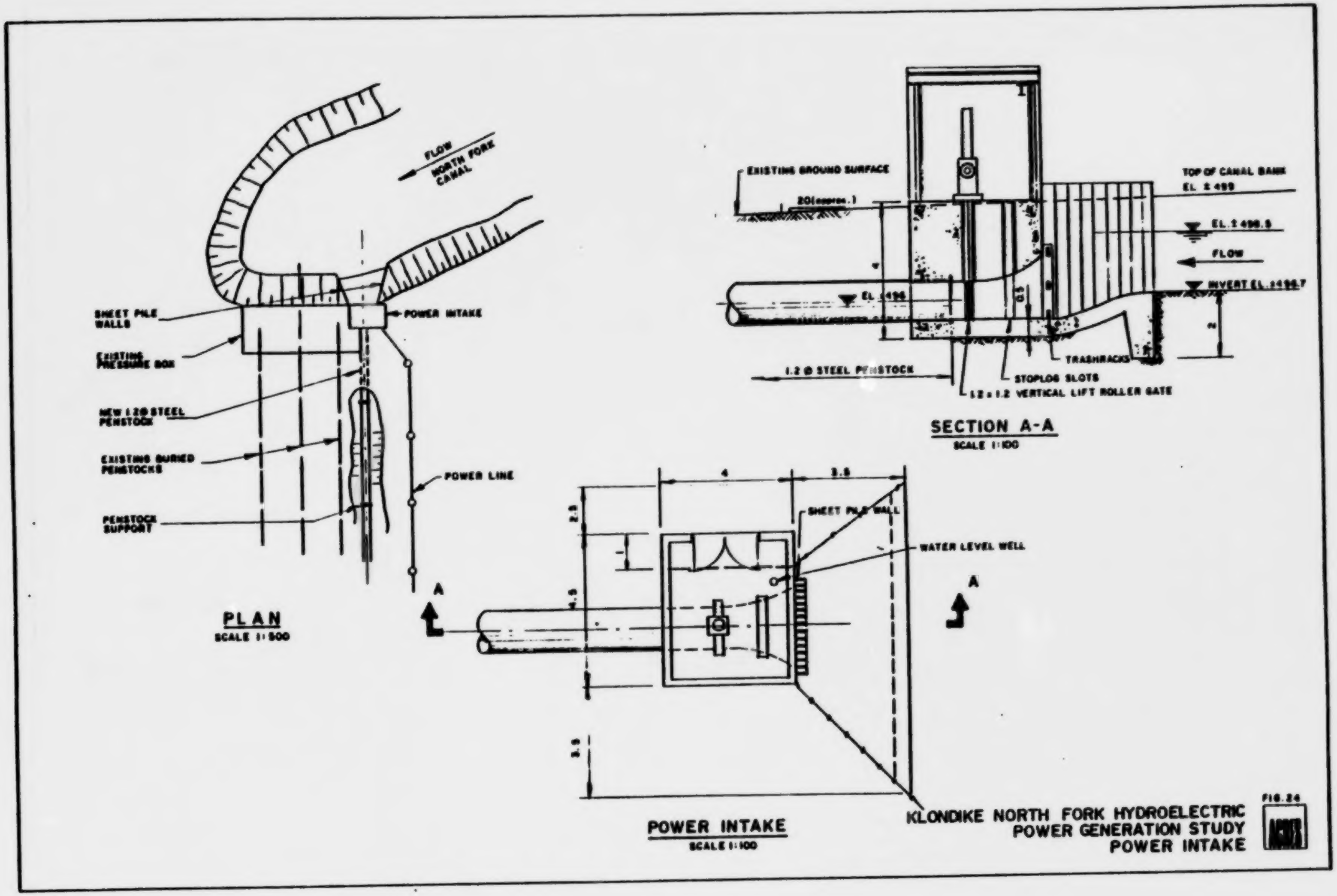
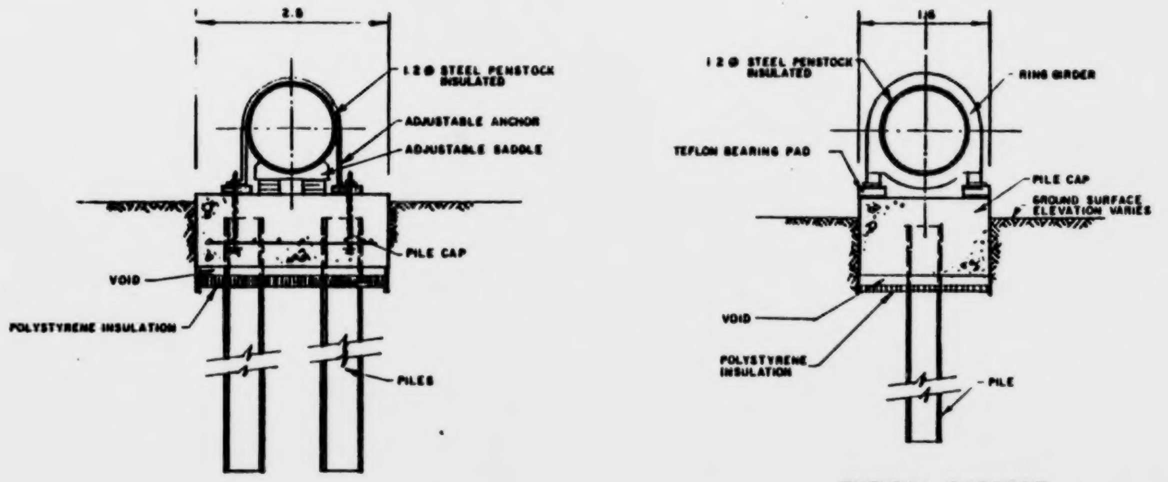

FLOW
NORTH FORK CANAL
SHEET PILE WALLS
EXISTING PRESSURE BOX
POWER INTAKE
NEW 1.2Ø STEEL PENSTOCK
EXISTING BURIED PENSTOCKS
PENSTOCK SUPPORT
POWER LINE
PLAN
SCALE 1:500
EXISTING GROUND SURFACE
20(approx.)
TOP OF CANAL BANK
EL. ± 499
EL. ± 498.5
FLOW
INVERT EL. ±496.7
EL. ±496
1.2 Ø STEEL PENSTOCK
TRASHRACKS
STOPLOG SLOTS
1.2 x 1.2 VERTICAL LIFT ROLLER GATE
SECTION A-A
SCALE 1:100
4
3.5
2.5
4.5
3.5
1
SHEET PILE WALL
WATER LEVEL WELL
A
A
POWER INTAKE
SCALE 1:100

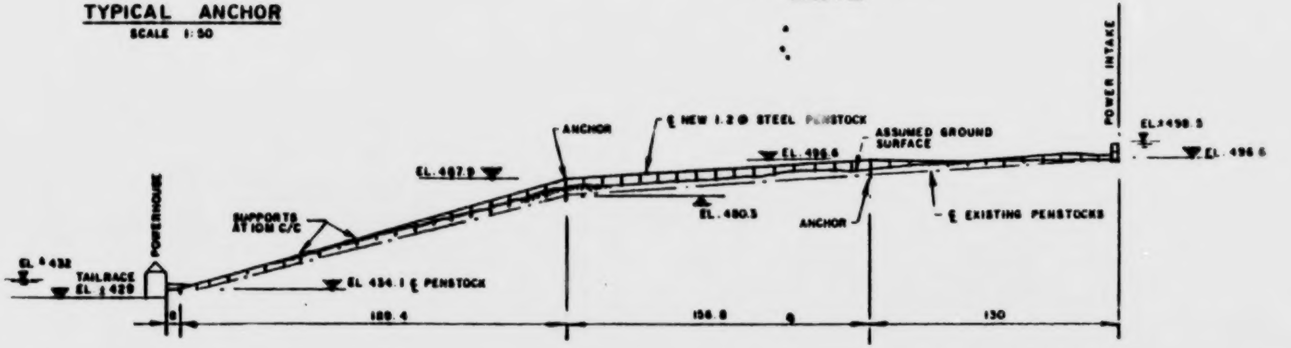
FIG. 24

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
POWER INTAKE


2.5
1.2 Ø STEEL PENSTOCK INSULATED
ADJUSTABLE ANCHOR
ADJUSTABLE SADDLE
PILE CAP
VOID
POLYSTYRENE INSULATION
PILES
1.6
1.2 Ø STEEL PENSTOCK INSULATED
RING GIRDER
TEFLON BEARING PAD
PILE CAP
GROUND SURFACE ELEVATION VARIES
VOID
POLYSTYRENE INSULATION
PILE

TYPICAL ANCHOR
SCALE 1:50

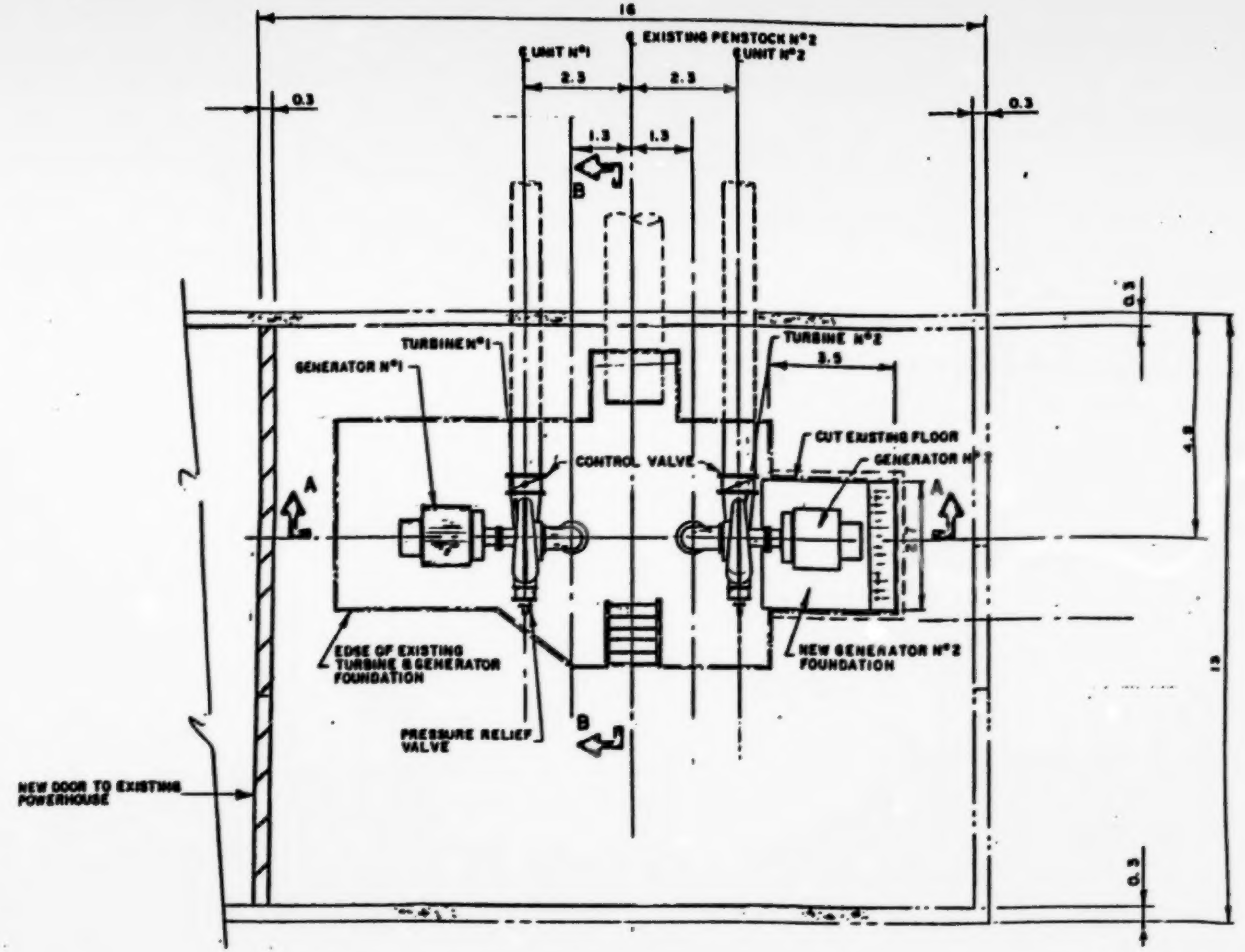
TYPICAL SUPPORT
SCALE 1:50


POWER INTAKE
EL. ± 498.5
EL. 496.6
ANCHOR
℄ NEW 1.2 Ø STEEL PENSTOCK
ASSUMED GROUND SURFACE
EL. 495.6
EL. 487.9
EL. 480.5
ANCHOR
℄ EXISTING PENSTOCKS
SUPPORTS AT 10 M C/C
POWERHOUSE
EL. ± 432
TAILRACE EL. ± 429
EL. 434.1 ℄ PENSTOCK
8
189.4
156.8
130

PENSTOCK PROFILE
SCALE 1:2000

FIG 25

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
PENSTOCK

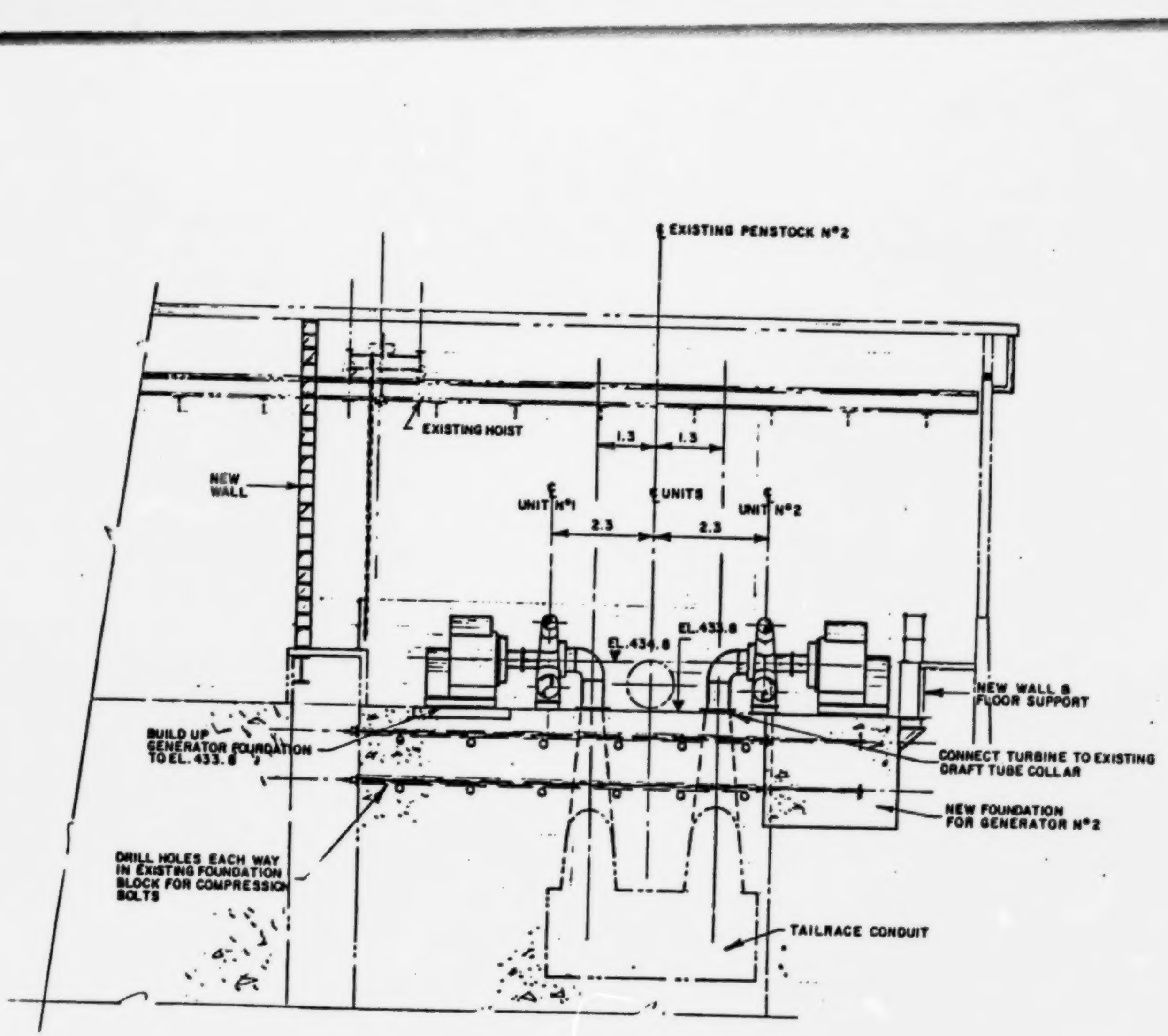

16
℄ UNIT N°1
℄ EXISTING PENSTOCK N°2
℄ UNIT N°2
2.3
2.3
0.3
0.3
1.3
1.3
B
B
A
A
TURBINE N°1
TURBINE N°2
GENERATOR N°1
3.5
CONTROL VALVE
CUT EXISTING FLOOR
GENERATOR N°2
4.8
0.3
13
0.3
EDGE OF EXISTING TURBINE & GENERATOR FOUNDATION
NEW GENERATOR N°2 FOUNDATION
PRESSURE RELIEF VALVE
NEW DOOR TO EXISTING POWERHOUSE

PLAN

Scale 1:100

Fig. 26
(part 1)

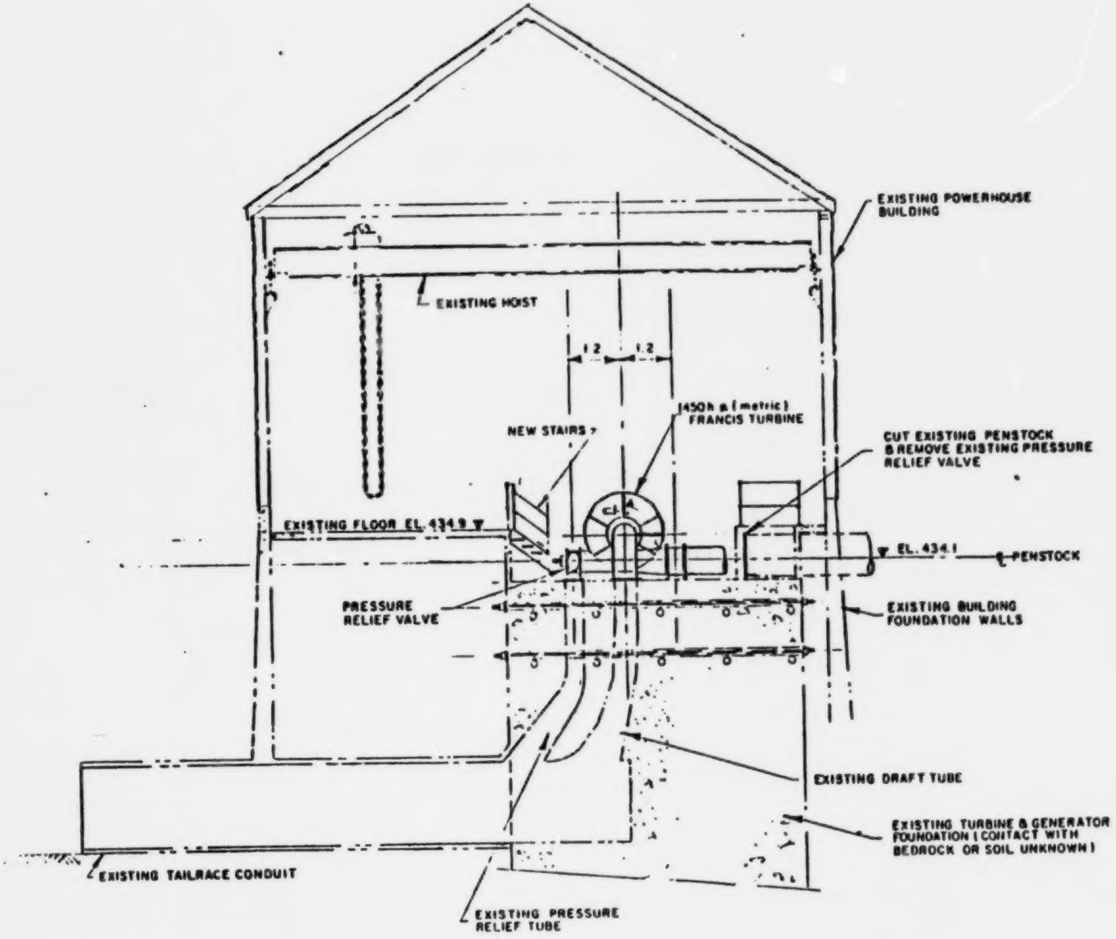
Klondike North Fork Hydroelectric
Power Generation Study
Powerhouse


℄ EXISTING PENSTOCK N°2
EXISTING HOIST
1.3
1.3
NEW WALL
℄ UNIT N°1
℄ UNITS
℄ UNIT N°2
2.3
2.3
EL. 434.8
EL. 433.8
NEW WALL & FLOOR SUPPORT
BUILD UP GENERATOR FOUNDATION TO EL. 433.8
CONNECT TURBINE TO EXISTING DRAFT TUBE COLLAR
NEW FOUNDATION FOR GENERATOR N°2
DRILL HOLES EACH WAY IN EXISTING FOUNDATION BLOCK FOR COMPRESSION BOLTS
TAILRACE CONDUIT

SECTION A-A

Fig. 26
(Part 2)

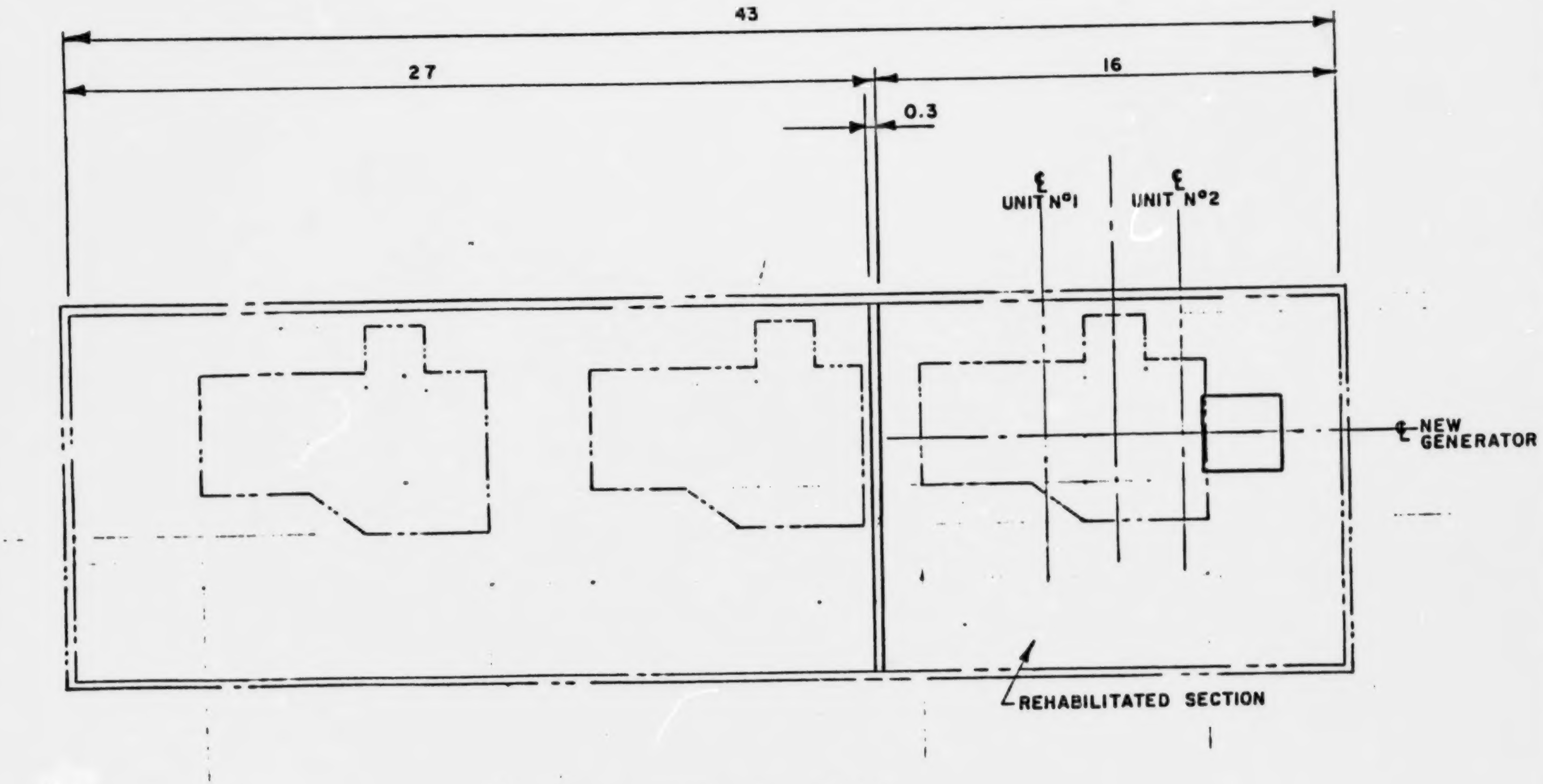
Klondike North Fork Hydroelectric
Power Generation Study
Powerhouse


EXISTING POWERHOUSE BUILDING
EXISTING HOIST
1.2
1.2
1450h.p. (metric) FRANCIS TURBINE
NEW STAIRS
CUT EXISTING PENSTOCK & REMOVE EXISTING PRESSURE RELIEF VALVE
EXISTING FLOOR EL. 434.9
EL. 434.1
℄ PENSTOCK
℄
PRESSURE RELIEF VALVE
EXISTING BUILDING FOUNDATION WALLS
EXISTING DRAFT TUBE
EXISTING TURBINE & GENERATOR FOUNDATION (CONTACT WITH BEDROCK OR SOIL UNKNOWN)
EXISTING TAILRACE CONDUIT
EXISTING PRESSURE RELIEF TUBE

SECTION B-B

Fig. 26
(part 3)

Klondike North Fork-Hydroelectric
Power Generation Study
Powerhouse


43
27
16
0.3
℄ UNIT N°1
℄ UNIT N°2
℄ NEW GENERATOR
REHABILITATED SECTION

POWERHOUSE PLAN

SCALE 1:200

Fig. 26
(part 4)
Klondike North Fork Hydroelectric
Power Generation Study
Powerhouse

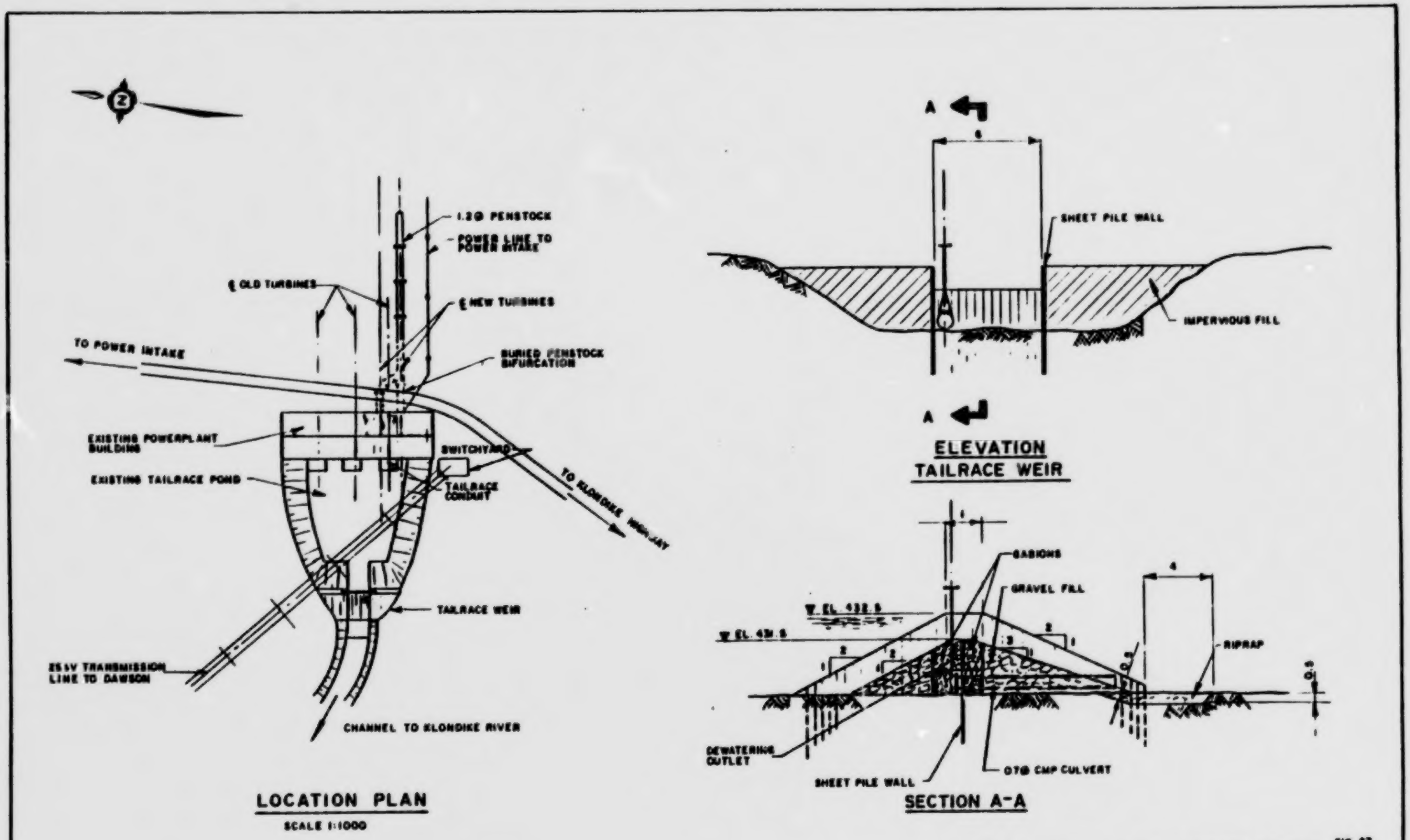
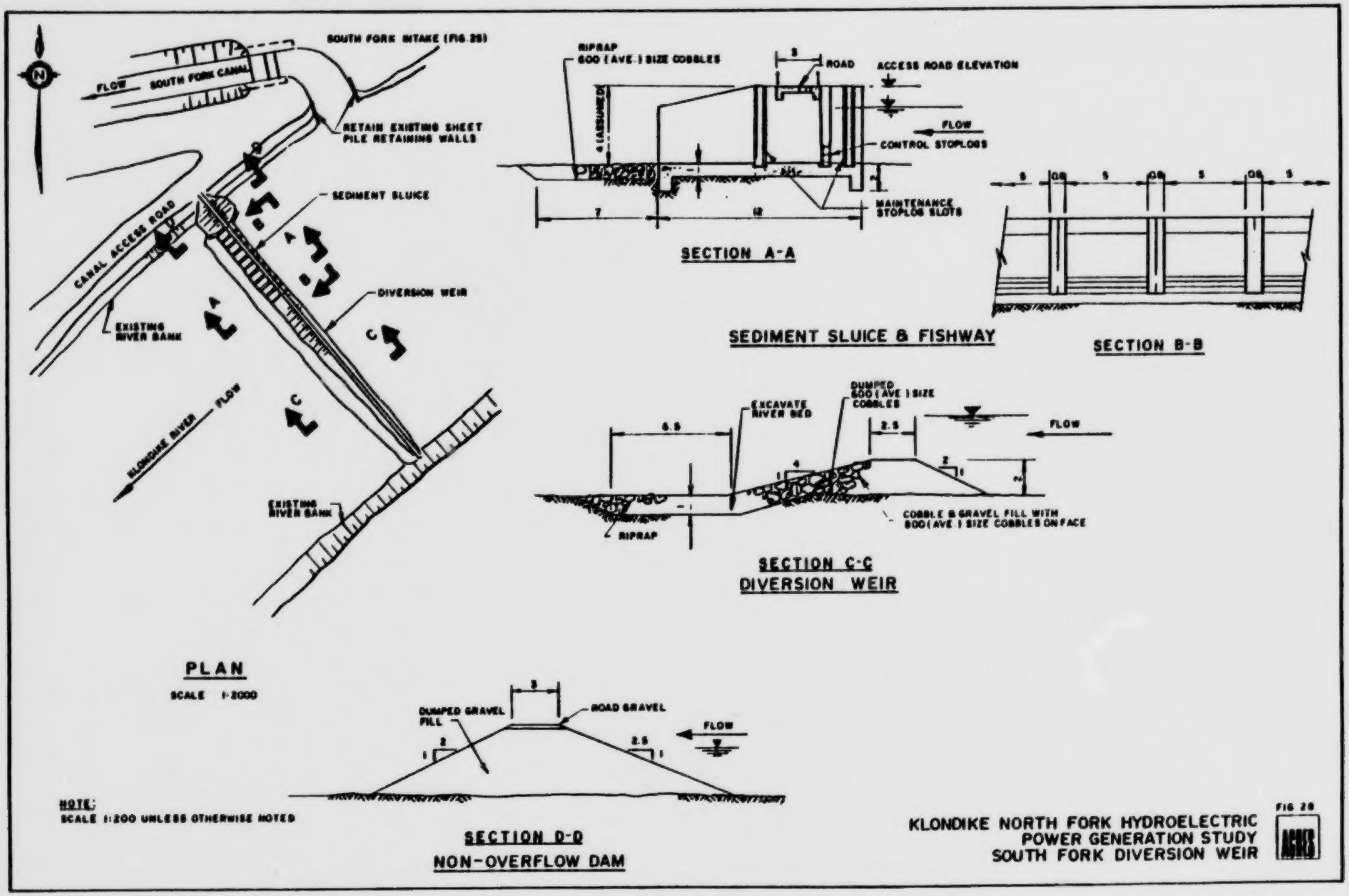

Z
1.2Ø PENSTOCK
POWER LINE TO POWER INTAKE
℄ OLD TURBINES
℄ NEW TURBINES
TO POWER INTAKE
BURIED PENSTOCK BIFURCATION
EXISTING POWERPLANT BUILDING
SWITCHYARD
EXISTING TAILRACE POND
TAILRACE CONDUIT
TO KLONDIKE HIGHWAY
TAILRACE WEIR
25 kV TRANSMISSION LINE TO DAWSON
CHANNEL TO KLONDIKE RIVER
LOCATION PLAN
SCALE 1:1000
A
A
6
SHEET PILE WALL
IMPERVIOUS FILL
ELEVATION
TAILRACE WEIR
1
GABIONS
GRAVEL FILL
4
▽ EL. 432.5
▽ EL. 431.5
2
1
2
1
3
1
2
1
0.5
RIPRAP
0.5
DEWATERING OUTLET
SHEET PILE WALL
0.7Ø CMP CULVERT
SECTION A-A

FIG. 27

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
POWERHOUSE LAYOUT & TAILRACE WEIR


N
FLOW
SOUTH FORK CANAL
SOUTH FORK INTAKE (FIG.25)
RETAIN EXISTING SHEET PILE RETAINING WALLS
CANAL ACCESS ROAD
SEDIMENT SLUICE
DIVERSION WEIR
EXISTING RIVER BANK
A
B
C
D
KLONDIKE RIVER
FLOW
EXISTING RIVER BANK
PLAN
SCALE 1:2000
RIPRAP
600 (AVE.) SIZE COBBLES
4 (ASSUMED)
3
ROAD
ACCESS ROAD ELEVATION
FLOW
CONTROL STOPLOGS
MAINTENANCE STOPLOG SLOTS
7
12
2
SECTION A-A
5
0.6
5
0.6
5
0.6
5
SECTION B-B
SEDIMENT SLUICE & FISHWAY
6.5
EXCAVATE RIVER BED
DUMPED 600 (AVE.) SIZE COBBLES
2.5
FLOW
4
1
2
1
2
RIPRAP
COBBLE & GRAVEL FILL WITH 600 (AVE.) SIZE COBBLES ON FACE
SECTION C-C
DIVERSION WEIR
3
DUMPED GRAVEL FILL
ROAD GRAVEL
FLOW
2
1
2.5
1
SECTION D-D
NON-OVERFLOW DAM
NOTE:
SCALE 1:200 UNLESS OTHERWISE NOTED
ACRES

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
SOUTH FORK DIVERSION WEIR

FIG 28

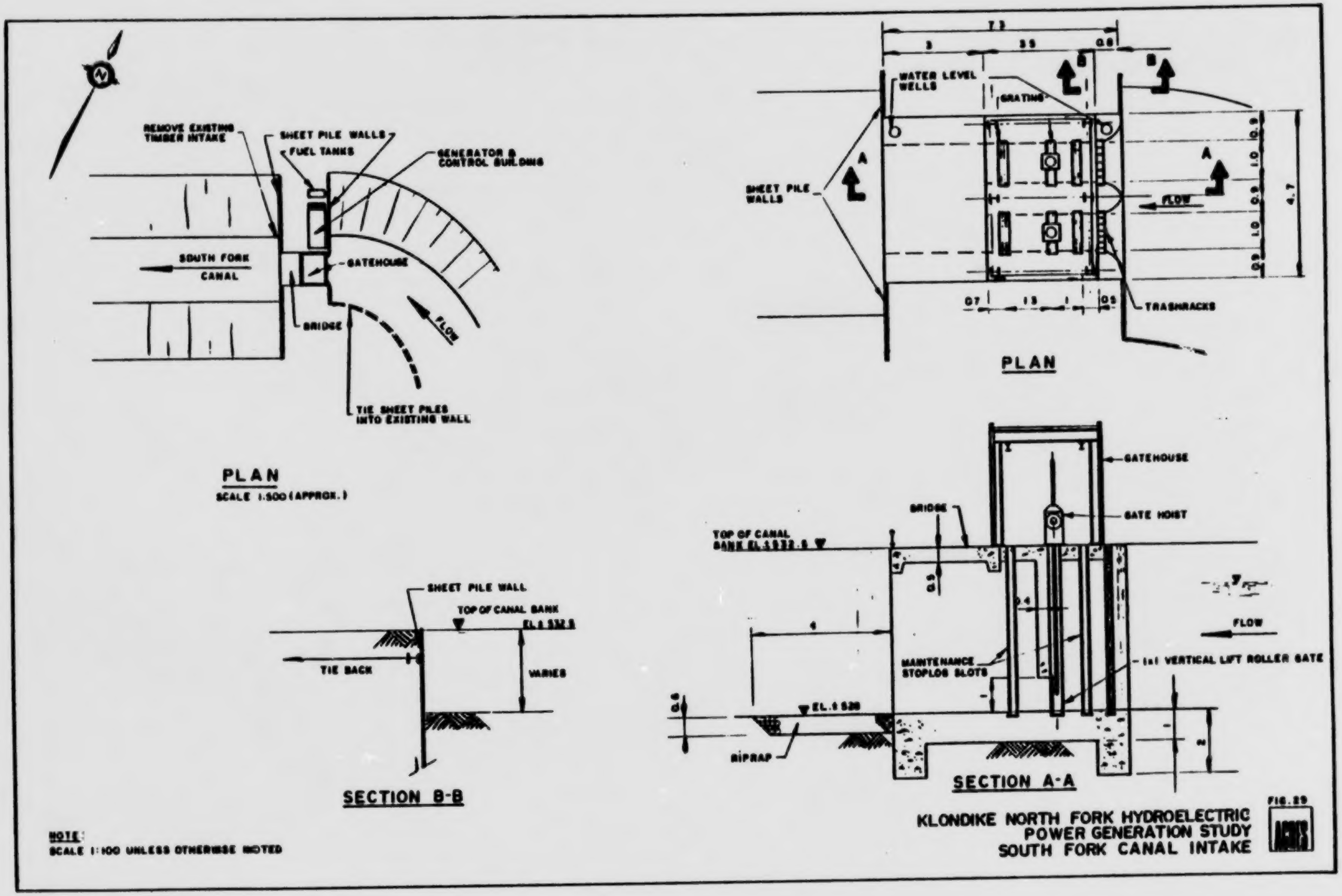
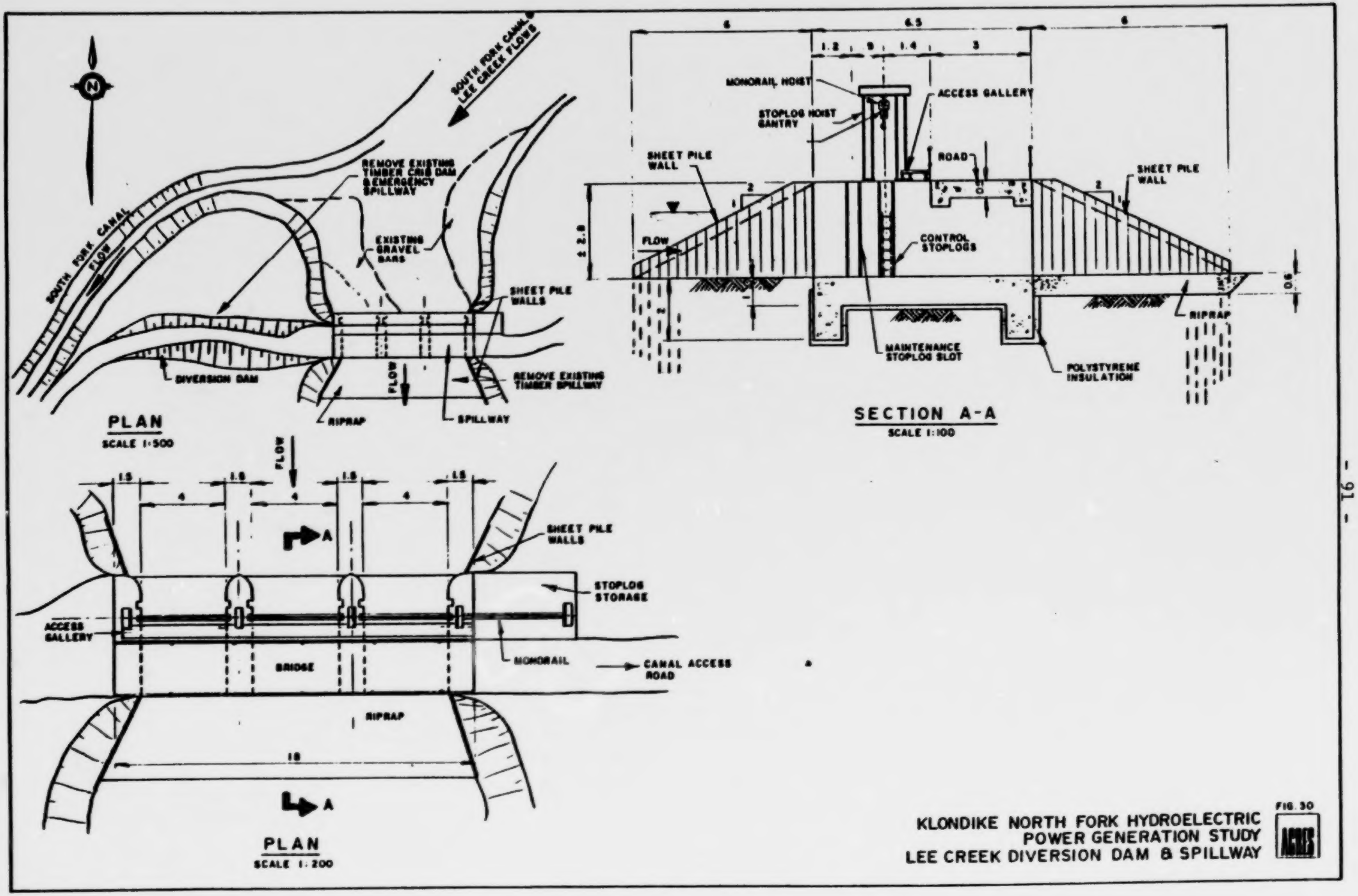

REMOVE EXISTING TIMBER INTAKE
SHEET PILE WALLS
FUEL TANKS
GENERATOR & CONTROL BUILDING
SOUTH FORK CANAL
GATEHOUSE
BRIDGE
FLOW
TIE SHEET PILES INTO EXISTING WALL
PLAN
SCALE 1:500 (APPROX.)
SHEET PILE WALL
TOP OF CANAL BANK
EL.1532.5
TIE BACK
VARIES
SECTION B-B
7.3
3
3.5
0.8
B
WATER LEVEL WELLS
GRATING
A
SHEET PILE WALLS
0.9
1.0
0.9
1.0
0.9
4.7
FLOW
0.7
1.3
1
0.5
TRASHRACKS
PLAN
GATEHOUSE
BRIDGE
GATE HOIST
TOP OF CANAL BANK EL.1532.5
0.5
0.4
4
FLOW
MAINTENANCE STOPLOG SLOTS
1x1 VERTICAL LIFT ROLLER GATE
0.6
EL.1528
RIPRAP
1
2
SECTION A-A
ACRES

FIG. 29

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
SOUTH FORK CANAL INTAKE

NOTE:
SCALE 1:100 UNLESS OTHERWISE NOTED


N
SOUTH FORK CANAL & LEE CREEK FLOWS
SOUTH FORK CANAL
FLOW
REMOVE EXISTING TIMBER CRIB DAM & EMERGENCY SPILLWAY
EXISTING GRAVEL BARS
SHEET PILE WALLS
DIVERSION DAM
FLOW
REMOVE EXISTING TIMBER SPILLWAY
RIPRAP
SPILLWAY
PLAN
SCALE 1:500
6
6.5
6
1.2
.9
1.4
3
MONORAIL HOIST
STOPLOG HOIST GANTRY
ACCESS GALLERY
ROAD
SHEET PILE WALL
SHEET PILE WALL
2
1
2
1
2.8
FLOW
CONTROL STOPLOGS
0.6
RIPRAP
MAINTENANCE STOPLOG SLOT
POLYSTYRENE INSULATION
SECTION A-A
SCALE 1:100
FLOW
1.5
4
1.5
4
1.5
4
1.5
A
SHEET PILE WALLS
STOPLOG STORAGE
ACCESS GALLERY
BRIDGE
MONORAIL
CANAL ACCESS ROAD
RIPRAP
18
A
PLAN
SCALE 1:200
FIG. 30
ACRES

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
LEE CREEK DIVERSION DAM & SPILLWAY

AGRES

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
PROJECT IMPLEMENTATION SCHEDULE
NORTH FORK DEVELOPMENT

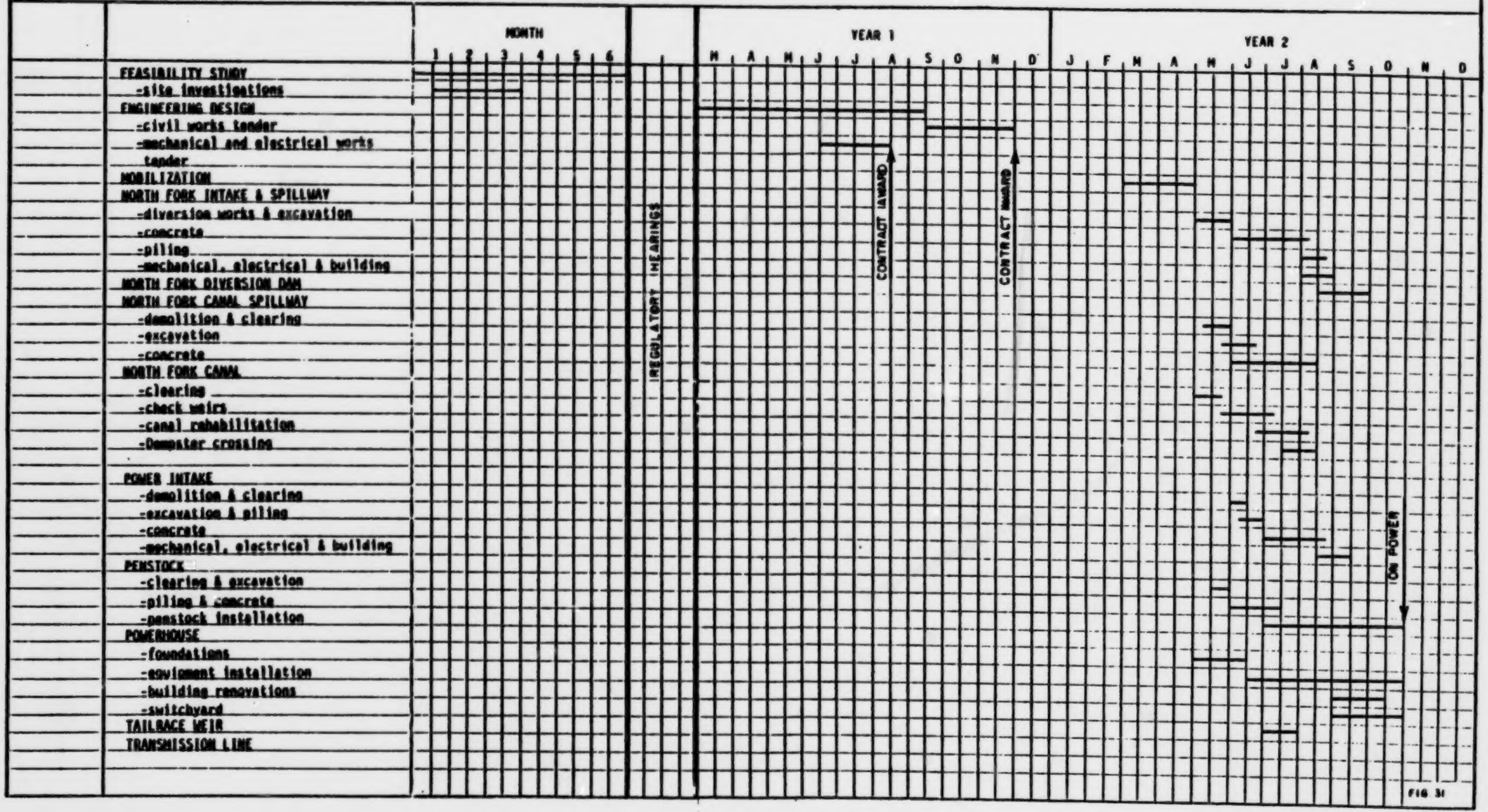


FIG 31

Form 276A

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
PROJECT IMPLEMENTATION SCHEDULE
NORTH & SOUTH FORK DEVELOPMENT
ADDITIONAL SOUTH FORK CANAL FACILITIES

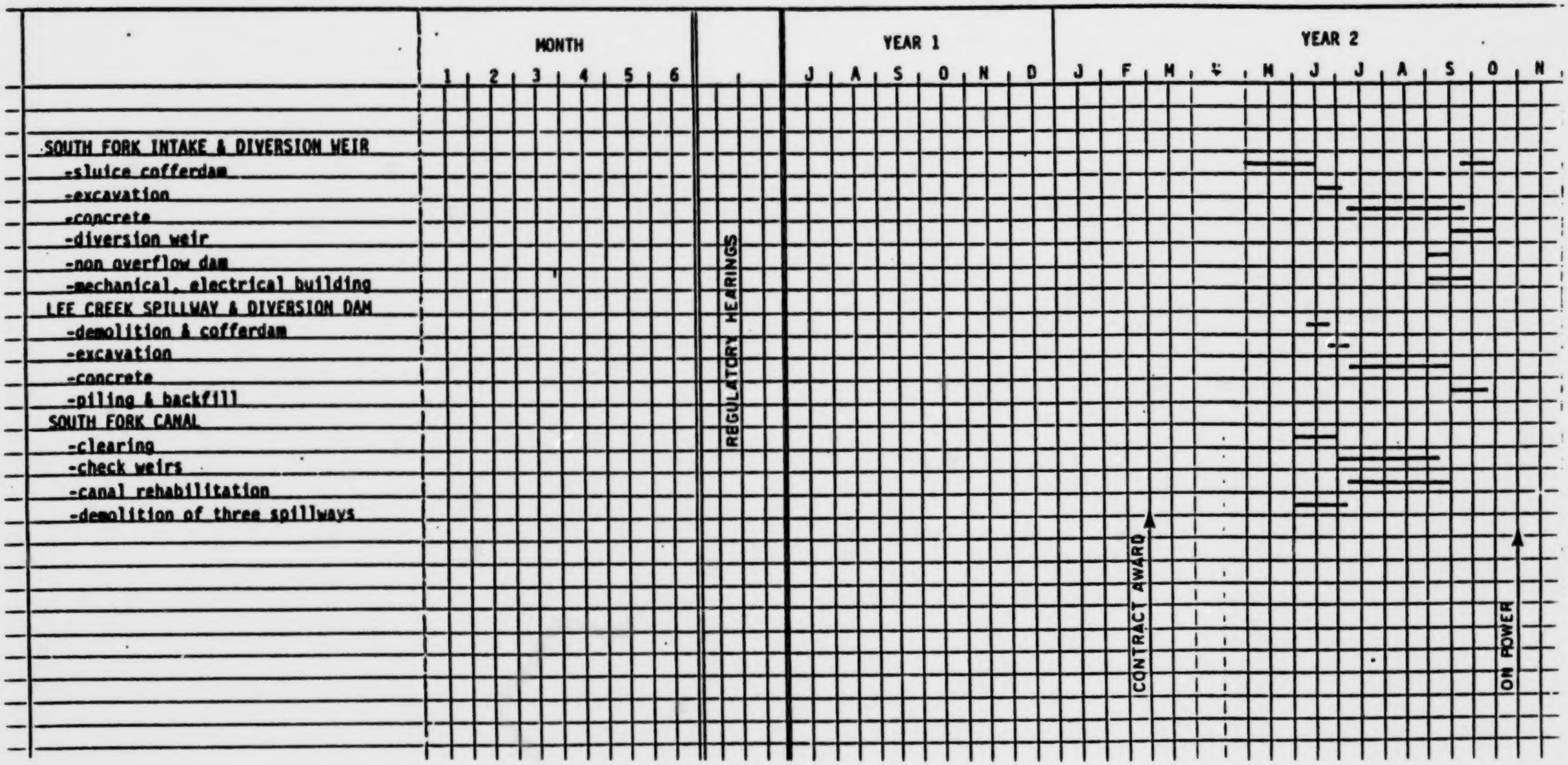


Fig. 32

APPENDIX A

KLONDIKE NORTH FORK HYDROELECTRIC POWER GENERATION STUDY SCOPE OF WORK

APPENDIX A

Scope of the Study

The scope of the study, covering both YECL and Acres efforts, and approved by Energy Mines and Resources, Canada, is as follows.

> "Objectives
>
> The primary objective of the study is to identify the most financially attractive form of redevelopment for the Klondike North Fork hydroelectric site, offering short-term implementation potential. In particular, recommendations and their rationale will be provided which address the following issues:
>
> (a) The extent to which the old facilities should be used, rehabilitated or replaced
> (b) the extent to which the site should provide firm electricity supply as opposed to fuel replacement energy
> (c) what allowance should be made for load growth in selecting the plant capacity
> (d) the best overall water-use plan to operate the plant
> (e) the costs, economic benefits, and financial viability of the project.
>
> Summary of Work Plan
>
> 1.0 A review of all available reports and operating experience will be conducted. As a minimum this will include;
> MONENCO (Montreal Engineering) Dawson City utilities interim report, October 28, 1961;
> NCPC draft of Dawson feasibility report, December 1975;
> MONENCO notes on North Fork rehabilitation dated October 19, 1976 and;
> interviews with available individuals previously associated with Granville Power Company and Yukon Consolidated Gold Company and assembly of all available operating records of these companies.
>
> 2.0 The target loads will be established based on proven or predictable power markets at or near the community of Dawson.

3.0 The flow hydrology will be assessed. As a minimum this assessment will include:

a review of the most current, relevant stream gauging records and an updating of the hydrological information contained in previous studies;
establishment of the firm water flows, drought frequency and magnitude, and determination of the relevant flow duration curve(s);
determination of the allowance for water losses and;
identification of flows diverted and not diverted at all control points for various operating scenarios and the corresponding dependable and average power available.

4.0 Photo-mosaics and/or maps at water diversion control structure sites will be prepared if adequate materials have not been developed in previous studies.

5.0 Field inspections will be conducted at the sites of the water diversion control structures, canals, penstocks, powerhouse and transmission line corridor. These inspections will include a prefeasibility geotechnical assessment for any new structures.

6.0 Based on the foregoing analyses, the nominal installed capacity will be recommended and the rationale for the decision summarized. The focus will be on the financially attractive alternative having the most promise for short-term implementation.

7.0 A prefeasibility design will include as a minimum:

the recommended modifications or improvements required on the canals;
drawings indicating the recommended configuration and approximate scale for the water control structures, headworks, penstock, powerhouse and turbine(s) and;
identify proposed solutions to problems related to winter operation of the long canals.

8.0 A prefeasibility level of cost estimate for the redevelopment will be prepared. The information provided by the preliminary design will be adequate to identify the design assumptions which are the basis for the cost estimate of the major capital components and will include the cost of the transmission line. The costs for the work related to the South Fork Canals and water control structures should be shown independent of that for the North Fork. A indication will be provided of the sensitivity of the capital costs to possible design flow reductions required by potential subsequent environmental regulation.

9.0 An economic and financial analysis will be conducted. All discount, inflation and escalation rates are to be identified. All assumptions will be identified together with a full description of the context of each assumption at the outset of the calculations. The analysis will account for the financial impact of a reduction from current usage levels in diesel waste heat for the City of Dawson. It is understood that much of the required data is available from NCPC. The cost of maintaining stand-by diesel power for the City of Dawson will also be included.

10.0 A draft final report will be prepared and presented to Energy, Mines and Resources Canada for comment. Those comments shall be taken into account and a final report prepared. The final report will fully incorporate the work of YECL and the consultant into one coherent document. The final report shall include as a minimum: executive summary, introduction, technical and economic discusson, conclusions, recommendations and references or bibliography. One reproducible original and five copies shall be provided to Energy, Mines and Resources.

11.0 YECL will present the findings, conclusions and recommendations of the Study at a meeting with the Dawson City Council for review and comment.

12.0 YECL will directly undertake or assist in a number of the work activities in the foregoing tasks. As a minimum YECL will undertake paragraphs 2.0 and 9.0. In addition YECL will provide assistance to work activities of paragraphs 1.0, 5.0 and 8.0 (transmission costs)."

APPENDIX B

ECONOMIC ANALYSES

ANNUAL SUMMARY OF ENERGY AND FUEL OIL DISPLACED

Page
North Fork 1000 kW Development - Case B Load Growth 100
North Fork 1000 kW Development - Case C Load Growth 101
North Fork 2000 kW Development - Case B Load Growth 102
North Fork 2000 kW Development - Case C Load Growth 103
North and South Fork 2000 kW Development - Case B Load Growth 104
North and South Fork 2000 kW Development - Case C Load Growth 105

KLONDIKE HYDROELECTRIC REDEVELOPMENT - NORTH FORK ONLY (1000 kW INSTALLED CAPACITY)

ANNUAL SUMMARY OF ENERGY AND FUEL OIL DISPLACED

	ENERGY REQUIREMENTS			HYDRO ENERGY		HYDRO ENERGY SUPPLIED			DIESEL ENERGY SUPPLIED			DISPLACED DIESEL	
YEAR	(1) ANNUAL MARKET (MW.h)	(2) ANNUAL AUXILIARY (MW.h)	(3) TOTAL ENERGY (MW.h)	(4) AVAILABLE HYDRO (MW.h)	(5) HYDRO NOT USED (MW.h)	(6) HYDRO ELECTRIC (MW.h)	(7) ELECTRIC BOILER (MW.h)	(8) TOTAL USED (MW.h)	(9) OIL BOILER (MW.h)	(10) DIESEL HEAT (MW.h)	(11) DIESEL ELECTRIC (MW.h)	(12) TOTAL LITRES (THOUSANDS)	(13) CUMULATIVE LITRES (THOUSANDS)
1984	8236	1834	10070	8655	1770	6303	582	6885	152	1100	1933	1861	1861
1985	8370	1846	10215	8655	1796	6305	555	6860	137	1154	2065	1864	3724
1986	8503	1857	10361	8655	1820	6305	531	6836	126	1200	2199	1865	5589
1987	8640	1869	10508	8655	1846	6305	505	6810	118	1246	2335	1866	7455
1988	8778	1881	10658	8655	1872	6305	478	6783	111	1292	2473	1867	9322
1989	8918	1892	10811	8655	1899	6305	451	6756	103	1338	2613	1868	11191
1990	9061	1904	10965	8655	1927	6305	424	6728	95	1386	2756	1869	13060
1991	9206	1917	11122	8655	1955	6305	396	6700	87	1434	2901	1870	14930
1992	9353	1929	11282	8655	1983	6305	367	6672	79	1483	3048	1871	16801
1993	9503	1941	11444	8655	2013	6305	338	6643	71	1532	3198	1872	18674
1994	9655	1953	11608	8655	2042	6305	308	6613	62	1583	3350	1874	20547
1995	9809	1966	11775	8655	2070	6305	281	6586	53	1632	3504	1875	22422
1996	9966	1978	11945	8655	2090	6305	260	6565	45	1674	3661	1876	24298
1997	10126	1991	12117	8655	2111	6305	239	6544	36	1716	3821	1877	26176
1998	10288	2004	12291	8655	2132	6305	218	6523	26	1759	3983	1878	28054
1999	10452	2017	12469	8655	2148	6305	202	6507	17	1797	4147	1880	29934
2000	10620	2030	12649	8655	2158	6305	192	6497	8	1830	4315	1881	31815
2001	10790	2043	12832	8655	2171	6305	180	6485	0	1863	4485	1882	33697
2002	10962	2056	13018	8655	2191	6305	159	6464	0	1897	4657	1882	35579
2003	11138	2069	13207	8655	2212	6305	139	6443	0	1931	4833	1882	37461
2004	11316	2082	13398	8655	2229	6305	122	6427	0	1961	5011	1882	39343
2005	11497	2096	13593	8655	2239	6305	111	6416	0	1985	5192	1882	41225
2006	11681	2110	13790	8655	2250	6305	101	6406	0	2009	5376	1882	43107
2007	11868	2123	13991	8655	2261	6305	90	6395	0	2033	5563	1882	44989
2008	12058	2137	14195	8655	2272	6305	79	6384	0	2058	5753	1882	46871
2009	12250	2151	14401	8655	2283	6305	68	6373	0	2083	5946	1882	48753
2010	12446	2165	14612	8655	2294	6305	56	6361	0	2109	6142	1882	50636
2011	12646	2179	14825	8655	2306	6305	45	6350	0	2135	6341	1882	52518
2012	12848	2194	15041	8655	2318	6305	33	6338	0	2161	6543	1882	54400
2013	13053	2208	15261	8655	2330	6305	21	6326	0	2187	6749	1882	56282

CASE B - 1.6% LOAD GROWTH

27-Mar-85

KLONDIKE HYDROELECTRIC REDEVELOPMENT - NORTH FORK ONLY (1000 kW INSTALLED CAPACITY)

ANNUAL SUMMARY OF ENERGY AND FUEL OIL DISPLACED

	ENERGY REQUIREMENTS			HYDRO ENERGY		HYDRO ENERGY SUPPLIED			DIESEL ENERGY SUPPLIED			DISPLACED DIESEL	
YEAR	(1) ANNUAL MARKET (MW.h)	(2) ANNUAL AUXILIARY (MW.h)	(3) TOTAL ENERGY (MW.h)	(4) AVAILABLE HYDRO (MW.h)	(5) HYDRO NOT USED (MW.h)	(6) HYDRO ELECTRIC (MW.h)	(7) ELECTRIC BOILER (MW.h)	(8) TOTAL USED (MW.h)	(9) OIL BOILER (MW.h)	(10) DIESEL HEAT (MW.h)	(11) DIESEL ELECTRIC (MW.h)	(12) TOTAL LITRES (THOUSANDS)	(13) CUMULATIVE LITRES (THOUSANDS)
1984	8236	1834	10070	8655	1770	6303	582	6885	152	1100	1933	1861	1861
1985	8703	1846	10549	8655	1840	6369	447	6815	160	1239	2334	1879	3740
1986	9108	1857	10965	8655	1900	6372	384	6755	107	1367	2736	1888	5628
1987	9512	1869	11381	8655	1964	6375	317	6691	58	1494	3137	1895	7523
1988	9917	1881	11797	8655	2036	6378	242	6619	31	1608	3539	1900	9423
1989	10321	1892	12214	8655	2082	6381	193	6574	3	1696	3941	1904	11327
1990	10726	1904	12630	8655	2131	6384	141	6524	0	1764	4342	1906	13232
1991	11130	1917	13047	8655	2166	6387	103	6489	0	1814	4744	1906	15139
1992	11535	1929	13464	8655	2190	6390	75	6465	0	1853	5145	1907	17046
1993	11939	1941	13880	8655	2215	6393	48	6441	0	1893	5547	1908	18954
1994	12344	1953	14297	8655	2239	6396	21	6416	0	1933	5948	1909	20864
1995	12748	1966	14714	8655	2257	6399	0	6399	0	1966	6350	1910	22774
1996	13153	1978	15131	8655	2254	6402	0	6402	0	1978	6751	1911	24685
1997	13558	1991	15549	8655	2251	6405	0	6405	0	1991	7153	1912	26596
1998	13962	2004	15966	8655	2248	6408	0	6408	0	2004	7555	1913	28509
1999	14367	2017	16383	8655	2245	6411	0	6411	0	2017	7956	1914	30423
2000	14771	2030	16801	8655	2242	6414	0	6414	0	2030	8358	1914	32337
2001	15176	2043	17218	8655	2239	6416	0	6416	0	2043	8759	1915	34252
2002	15580	2056	17636	8655	2236	6419	0	6419	0	2056	9161	1916	36169
2003	15985	2069	18054	8655	2233	6422	0	6422	0	2069	9562	1917	38086
2004	16389	2082	18472	8655	2230	6425	0	6425	0	2082	9964	1918	40004
2005	16794	2096	18890	8655	2227	6428	0	6428	0	2096	10365	1919	41923
2006	17198	2110	19308	8655	2224	6431	0	6431	0	2110	10767	1920	43843
2007	17603	2123	19726	8655	2221	6434	0	6434	0	2123	11168	1921	45763
2008	18007	2137	20144	8655	2218	6437	0	6437	0	2137	11570	1922	47685
2009	18412	2151	20563	8655	2215	6440	0	6440	0	2151	11972	1922	49607
2010	18816	2165	20982	8655	2212	6443	0	6443	0	2165	12373	1923	51531
2011	19221	2179	21400	8655	2209	6446	0	6446	0	2179	12775	1924	53455
2012	19626	2194	21819	8655	2206	6449	0	6449	0	2194	13176	1925	55380
2013	20030	2208	22238	8655	2203	6452	0	6452	0	2208	13578	1926	57306

CASE C - 70 kW ADDED TO YEARLY PEAK

27-Mar-85

KLONDIKE HYDROELECTRIC REDEVELOPMENT - NORTH FORK ONLY (2000 KW INSTALLED CAPACITY)

ANNUAL SUMMARY OF ENERGY AND FUEL OIL DISPLACED

	ENERGY REQUIREMENTS			HYDRO ENERGY		HYDRO ENERGY SUPPLIED			DIESEL ENERGY SUPPLIED			DISPLACED DIESEL	
YEAR	(1) ANNUAL MARKET (MW.h)	(2) ANNUAL AUXILIARY (MW.h)	(3) TOTAL ENERGY (MW.h)	(4) AVAILABLE HYDRO (MW.h)	(5) HYDRO NOT USED (MW.h)	(6) HYDRO ELECTRIC (MW.h)	(7) ELECTRIC BOILER (MW.h)	(8) TOTAL USED (MW.h)	(9) OIL BOILER (MW.h)	(10) DIESEL HEAT (MW.h)	(11) DIESEL ELECTRIC (MW.h)	(12) TOTAL LITRES (THOUSANDS)	(13) CUMULATIVE LITRES (THOUSANDS)
1984	8236	1834	10070	11250	1751	8037	1463	9500	172	199	199	2376	2376
1985	8370	1846	10215	11454	1855	8141	1458	9599	158	229	229	2409	4784
1986	8503	1857	10361	11558	1852	8239	1467	9706	126	264	264	2442	7227
1987	8640	1869	10508	11687	1882	8340	1465	9806	105	299	299	2476	9702
1988	8778	1881	10658	11842	1957	8431	1453	9884	81	346	346	2506	12208
1989	8918	1892	10811	11932	1966	8534	1433	9967	75	385	385	2537	14745
1990	9061	1904	10965	12101	2057	8634	1411	10045	66	427	427	2568	17313
1991	9206	1917	11122	12227	2109	8733	1385	10118	59	472	472	2599	19912
1992	9353	1929	11282	12353	2168	8831	1354	10186	52	522	522	2629	22541
1993	9503	1941	11444	12502	2243	8932	1327	10259	42	571	571	2660	25202
1994	9655	1953	11608	12602	2268	9035	1299	10334	35	619	619	2692	27894
1995	9809	1966	11775	12787	2381	9137	1269	10406	24	673	673	2724	30618
1996	9966	1978	11945	12883	2402	9242	1238	10481	16	724	724	2757	33375
1997	10126	1991	12117	13076	2522	9348	1206	10554	8	778	778	2789	36165
1998	10288	2004	12291	13230	2617	9448	1164	10613	0	839	839	2820	38985
1999	10452	2017	12469	13348	2677	9553	1118	10671	0	899	899	2852	41837
2000	10620	2030	12649	13572	2857	9652	1062	10715	0	967	967	2881	44718
2001	10790	2043	12832	13616	2844	9759	1012	10772	0	1030	1030	2913	47631
2002	10962	2056	13018	13834	3027	9856	950	10807	0	1106	1106	2942	50574
2003	11138	2069	13207	13877	3017	9964	895	10859	0	1174	1174	2974	53548
2004	11316	2082	13398	14099	3182	10075	842	10917	0	1241	1241	3007	56555
2005	11497	2096	13593	14172	3203	10185	784	10969	0	1312	1312	3040	59596
2006	11681	2110	13790	14277	3314	10267	696	10963	0	1414	1414	3065	62660
2007	11868	2123	13991	14422	3448	10348	626	10974	0	1497	1519	3089	65749
2008	12058	2137	14195	14453	3456	10432	565	10997	0	1572	1626	3114	68863
2009	12250	2151	14401	14587	3590	10499	498	10997	0	1653	1751	3134	71997
2010	12446	2165	14612	14627	3594	10564	468	11033	0	1697	1882	3154	75151
2011	12646	2179	14825	14651	3614	10609	428	11037	0	1751	2037	3167	78318
2012	12848	2194	15041	14690	3655	10639	396	11035	0	1798	2209	3176	81494
2013	13053	2208	15261	14690	3657	10670	363	11033	0	1845	2383	3185	84679

CASE B - 1.6% LOAD GROWTH

27-Mar-85

KLONDIKE HYDROELECTRIC REDEVELOPMENT - NORTH FORK ONLY (2000 KW INSTALLED CAPACITY)

ANNUAL SUMMARY OF ENERGY AND FUEL OIL DISPLACED

	ENERGY REQUIREMENTS			HYDRO ENERGY		HYDRO ENERGY SUPPLIED			DIESEL ENERGY SUPPLIED			DISPLACED DIESEL	
YEAR	(1) ANNUAL MARKET (MW.h)	(2) ANNUAL AUXILIARY (MW.h)	(3) TOTAL ENERGY (MW.h)	(4) AVAILABLE HYDRO (MW.h)	(5) HYDRO NOT USED (MW.h)	(6) HYDRO ELECTRIC (MW.h)	(7) ELECTRIC BOILER (MW.h)	(8) TOTAL USED (MW.h)	(9) OIL BOILER (MW.h)	(10) DIESEL HEAT (MW.h)	(11) DIESEL ELECTRIC (MW.h)	(12) TOTAL LITRES (THOUSANDS)	(13) CUMULATIVE LITRES (THOUSANDS)
1984	8236	1834	10070	11250	1751	8037	1463	9500	172	199	199	2376	2376
1985	8703	1846	10549	11688	1891	8396	1401	9797	136	308	308	2488	4863
1986	9108	1857	10965	12063	2027	8683	1353	10036	80	425	425	2581	7444
1987	9512	1869	11381	12427	2182	8960	1285	10245	32	552	552	2670	10115
1988	9917	1881	11797	12797	2370	9234	1193	10427	5	683	683	2756	12870
1989	10321	1892	12214	13156	2591	9497	1068	10565	0	824	824	2835	15705
1990	10726	1904	12630	13571	2895	9749	928	10677	0	977	977	2910	18616
1991	11130	1917	13047	13840	3072	9991	777	10768	0	1139	1139	2982	21598
1992	11535	1929	13464	14135	3259	10241	635	10875	0	1294	1294	3057	24655
1993	11939	1941	13880	14422	3503	10426	493	10919	0	1448	1514	3112	27767
1994	12344	1953	14297	14587	3598	10590	399	10989	0	1555	1754	3161	30928
1995	12748	1966	14714	14651	3606	10701	344	11045	0	1621	2047	3194	34123
1996	13153	1978	15131	14690	3637	10764	289	11053	0	1690	2389	3213	37336
1997	13558	1991	15549	14729	3662	10823	244	11067	0	1747	2735	3231	40567
1998	13962	2004	15966	14734	3700	10843	191	11034	0	1813	3119	3237	43803
1999	14367	2017	16383	14734	3750	10853	130	10984	0	1886	3513	3240	47043
2000	14771	2030	16801	14734	3800	10864	69	10934	0	1960	3907	3243	50286
2001	15176	2043	17218	14734	3850	10875	9	10884	0	2034	4301	3246	53532
2002	15580	2056	17636	14734	3848	10886	0	10886	0	2056	4694	3250	56782
2003	15985	2069	18054	14734	3837	10897	0	10897	0	2069	5088	3253	60035
2004	16389	2082	18472	14734	3827	10908	0	10908	0	2082	5482	3256	63291
2005	16794	2096	18890	14734	3816	10918	0	10918	0	2096	5875	3259	66550
2006	17198	2110	19308	14734	3805	10929	0	10929	0	2110	6269	3262	69812
2007	17603	2123	19726	14734	3794	10940	0	10940	0	2123	6663	3266	73078
2008	18007	2137	20144	14734	3783	10951	0	10951	0	2137	7057	3269	76347
2009	18412	2151	20563	14734	3773	10962	0	10962	0	2151	7450	3272	79619
2010	18816	2165	20982	14734	3762	10972	0	10972	0	2165	7844	3275	82894
2011	19221	2179	21400	14734	3751	10983	0	10983	0	2179	8238	3279	86173
2012	19626	2194	21819	14734	3740	10994	0	10994	0	2194	8632	3282	89455
2013	20030	2208	22238	14734	3729	11005	0	11005	0	2208	9025	3285	92740

KLONDIKE HYDROELECTRIC REDEVELOPMENT - NORTH FORK AND SOUTH FORK (2000 KW INSTALLED CAPACITY)

ANNUAL SUMMARY OF ENERGY AND FUEL OIL DISPLACED

ENERGY REQUIREMENTS			HYDRO ENERGY		HYDRO ENERGY SUPPLIED			DIESEL ENERGY SUPPLIED			DISPLACED DIESEL	
(1) ANNUAL MARKET (MW.h)	(2) ANNUAL AUXILIARY (MW.h)	(3) TOTAL ENERGY (MW.h)	(4) AVAILABLE HYDRO (MW.h)	(5) HYDRO NOT USED (MW.h)	(6) HYDRO ELECTRIC (MW.h)	(7) ELECTRIC BOILER (MW.h)	(8) TOTAL USED (MW.h)	(9) OIL BOILER (MW.h)	(10) DIESEL HEAT (MW.h)	(11) DIESEL ELECTRIC (MW.h)	(12) TOTAL LITRES (THOUSANDS)	(13) CUMULATIVE LITRES (THOUSANDS)
8236	1834	10070	11945	1878	8236	1831	10067	3	0	0	2458	2458
8370	1846	10215	12166	1966	8370	1830	10200	15	0	0	2496	4954
8503	1857	10361	12346	1998	8503	1845	10348	12	0	0	2537	7491
8640	1869	10508	12530	2028	8640	1862	10502	7	0	0	2578	10069
8778	1881	10658	12748	2091	8778	1879	10657	1	0	0	2620	12689
8918	1892	10811	12857	2061	8918	1878	10796	15	0	0	2660	15349
9061	1904	10965	13115	2162	9061	1893	10954	12	0	0	2703	18052
9206	1917	11122	13296	2178	9206	1912	11118	5	0	0	2747	20800
9353	1929	11282	13479	2221	9353	1906	11259	23	0	0	2789	23589
9503	1941	11444	13698	2254	9503	1941	11444	0	0	0	2837	26425
9655	1953	11608	13882	2283	9655	1944	11598	10	0	0	2881	29306
9809	1966	11775	14102	2340	9809	1953	11763	13	0	0	2926	32233
9966	1978	11945	14320	2377	9966	1977	11943	2	0	0	2975	35207
10126	1991	12117	14541	2448	10126	1967	12093	24	0	0	3019	38227
10288	2004	12291	14831	2540	10288	2004	12291	0	0	0	3071	41298
10452	2017	12469	15013	2554	10452	2007	12459	10	0	0	3119	44416
10620	2030	12649	15343	2694	10620	2030	12649	0	0	0	3170	47586
10790	2043	12832	15451	2623	10790	2039	12828	4	0	0	3220	50807
10962	2056	13018	15781	2763	10962	2056	13018	0	0	0	3272	54079
11138	2069	13207	15890	2683	11138	2069	13207	0	0	0	3325	57404
11316	2082	13398	16220	2837	11316	2067	13383	16	0	0	3376	60779
11497	2096	13593	16402	2814	11495	2094	13588	0	2	2	3431	64210
11681	2110	13790	16547	2839	11646	2062	13708	12	35	35	3475	67685
11868	2123	13991	16803	2937	11797	2069	13866	0	54	71	3522	71207
12058	2137	14195	16909	2937	11934	2038	13972	10	90	123	3561	74768
12250	2151	14401	17093	3026	12057	2010	14067	0	141	194	3599	78367
12446	2165	14612	17166	3003	12176	1988	14163	8	169	271	3633	82000
12646	2179	14825	17239	3034	12258	1947	14205	0	232	388	3659	85659
12848	2194	15041	17312	3109	12320	1883	14203	8	302	528	3676	89336
13053	2208	15261	17350	3133	12382	1834	14217	0	373	671	3696	93032

CASE B - 1.6% LOAD GROWTH

27-Mar-85

KLONDIKE HYDROELECTRIC REDEVELOPMENT - NORTH FORK AND SOUTH FORK (2000 KW INSTALLED CAPACITY)

ANNUAL SUMMARY OF ENERGY AND FUEL OIL DISPLACED

ENERGY REQUIREMENTS			HYDRO ENERGY		HYDRO ENERGY SUPPLIED			DIESEL ENERGY SUPPLIED			DISPLACED DIESEL	
(1) ANNUAL MARKET (MW.h)	(2) ANNUAL AUXILIARY (MW.h)	(3) TOTAL ENERGY (MW.h)	(4) AVAILABLE HYDRO (MW.h)	(5) HYDRO NOT USED (MW.h)	(6) HYDRO ELECTRIC (MW.h)	(7) ELECTRIC BOILER (MW.h)	(8) TOTAL USED (MW.h)	(9) OIL BOILER (MW.h)	(10) DIESEL HEAT (MW.h)	(11) DIESEL ELECTRIC (MW.h)	(12) TOTAL LITRES (THOUSANDS)	(13) CUMULATIVE LITRES (THOUSANDS)
8236	1834	10070	11945	1878	8236	1831	10067	3	0	0	2458	2458
8703	1846	10549	12597	2049	8703	1846	10549	0	0	0	2598	5056
9108	1857	10965	13109	2160	9108	1841	10949	16	0	0	2717	7773
9512	1869	11381	13622	2254	9512	1855	11367	14	0	0	2838	10610
9917	1881	11797	14170	2384	9917	1869	11786	11	0	0	2959	13569
10321	1892	12214	14755	2550	10321	1883	12205	9	0	0	3080	16649
10726	1904	12630	15340	2718	10726	1896	12622	8	0	0	3201	19849
11130	1917	13047	15815	2779	11130	1906	13036	10	0	0	3321	23170
11535	1929	13464	16291	2840	11535	1916	13451	12	0	0	3442	26612
11939	1941	13880	16766	3022	11871	1873	13744	15	54	68	3542	30153
12344	1953	14297	17018	3090	12150	1778	13928	36	140	194	3622	33775
12748	1956	14714	17165	3141	12350	1674	14024	58	234	399	3679	37454
13153	1978	15131	17275	3224	12475	1577	14052	29	372	678	3720	41174
13558	1991	15549	17386	3364	12573	1449	14022	7	536	985	3752	44926
13962	2004	15966	17532	3579	12644	1310	13953	0	694	1319	3774	48700
14367	2017	16383	17532	3650	12706	1176	13882	0	840	1661	3793	52493
14771	2030	16801	17532	3803	12718	1010	13729	0	1019	2053	3797	56290
15176	2043	17218	17532	3976	12721	835	13556	0	1208	2454	3797	60087
15580	2056	17636	17532	4096	12724	711	13436	0	1344	2856	3798	63885
15985	2069	18054	17532	4208	12727	597	13324	0	1472	3257	3799	67685
16389	2082	18472	17532	4319	12730	482	13213	0	1600	3659	3800	71485
16794	2096	18890	17532	4431	12733	368	13101	0	1728	4060	3801	75286
17198	2110	19308	17532	4516	12736	280	13016	0	1830	4462	3802	79088
17603	2123	19726	17532	4574	12739	218	12958	0	1905	4864	3803	82890
18007	2137	20144	17532	4610	12742	180	12922	0	1957	5265	3804	86694
18412	2151	20563	17532	4634	12745	153	12898	0	1998	5667	3805	90499
18816	2165	20982	17532	4657	12748	126	12875	0	2039	6068	3805	94304
19221	2179	21400	17532	4681	12751	99	12851	0	2080	6470	3806	98110
19626	2194	21819	17532	4705	12754	73	12827	0	2121	6871	3807	101918
20030	2208	22238	17532	4729	12757	46	12803	0	2162	7273	3808	105726

CASE C - 70 kW ADDED TO YEARLY PEAK

27-Mar-85

ECONOMIC ANALYSIS

NORTH FORK 1000 kW INSTALLATION
CASE A LOAD GROWTH

Page	Return/Discount Rate	Inflation Rate	Fuel Escalation Rate
B-9	13%	5%	4%
B-10	13%	5%	5%
B-11	13%	5%	6%
B-12	10%	5%	5%

CAPITAL COST HYDRO ($)	5100000
LIFETIME (YEARS)	30
RETURN/DISCOUNT RATE	13%
INFLATION RATE	5%
FUEL ESCALATION RATE	4%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH FORK ONLY - 1000 KW INSTALLATION
CASE A - 0 % LOAD GROWTH

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/KWh.)	DIESEL ENERGY	DIESEL (C/KWh.)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	5100000	170000	663000	0	25000	151584	5.6	1932821	12.3	246032	1104032	977020	8235788	1012178	-91854	-81287
1985	4930000	170000	640900	0	26250	151584	5.8	1932821	12.8	255874	1093024	1833018	8235788	1052665	-40358	-112893
1986	4760000	170000	618800	0	27563	151584	6.1	1932821	13.3	266109	1082471	2583224	8235788	1094772	12301	-104368
1987	4590000	170000	596700	0	28941	151584	6.3	1932821	13.8	276753	1072394	3240944	8235788	1138563	66169	-63785
1988	4420000	170000	574600	0	30388	151584	6.6	1932821	14.4	287823	1062811	3817795	8235788	1184106	121295	2049
1989	4250000	170000	552500	0	31907	151584	6.8	1932821	15.0	299336	1053743	4323927	8235788	1231470	177727	87414
1990	4080000	170000	530400	0	33502	151584	7.1	1932821	15.6	311309	1045212	4768205	8235788	1280729	235517	187523
1991	3910000	170000	508300	0	35178	151584	7.4	1932821	16.2	323762	1037239	5158373	8235788	1331958	294718	298384
1992	3740000	170000	486200	0	36936	151584	7.7	1932821	16.8	336712	1029849	5501194	8235788	1385236	355387	416687
1993	3570000	170000	464100	0	38783	151584	8.0	1932821	17.5	350181	1023064	5802577	8235788	1440645	417581	539702
1994	3400000	170000	442000	0	40722	151584	8.3	1932821	18.2	364188	1016910	6067683	8235788	1498271	481361	665192
1995	3230000	170000	419900	0	42758	151584	8.6	1932821	18.9	378756	1011414	6301022	8235788	1558202	546788	791339
1996	3060000	170000	397800	0	44896	151584	9.0	1932821	19.7	393906	1006602	6506535	8235788	1620530	613928	916681
1997	2890000	170000	375700	0	47141	151584	9.3	1932821	20.5	409662	1002503	6687664	8235788	1685351	682848	1040056
1998	2720000	170000	353600	0	49498	151584	9.7	1932821	21.3	426048	999147	6847418	8235788	1752765	753619	1160552
1999	2550000	170000	331500	0	51973	151584	10.1	1932821	22.1	443090	996564	6988428	8235788	1822876	826312	1277473
2000	2380000	170000	309400	0	54572	151584	10.5	1932821	23.0	460814	994786	7112993	8235788	1895791	901005	1390295
2001	2210000	170000	287300	0	57300	151584	10.9	1932821	23.9	479247	993847	7223123	8235788	1971623	977776	1498644
2002	2040000	170000	265200	0	60165	151584	11.3	1932821	24.9	498416	993782	7320578	8235788	2050488	1056706	1602269
2003	1870000	170000	243100	0	63174	151584	11.8	1932821	25.9	518353	994627	7406894	8235788	2132507	1137880	1701017
2004	1700000	170000	221000	0	66332	151584	12.3	1932821	26.9	539087	996420	7483417	8235788	2217807	1221388	1794817
2005	1530000	170000	198900	0	69649	151584	12.8	1932821	28.0	560651	999200	7551326	8235788	2306520	1307320	1883667
2006	1360000	170000	176800	0	73132	151584	13.3	1932821	29.1	583077	1003008	7611651	8235788	2398780	1395772	1967615
2007	1190000	170000	154700	0	76788	151584	13.8	1932821	30.3	606400	1007888	7665296	8235788	2494732	1486844	2046753
2008	1020000	170000	132600	0	80627	151584	14.4	1932821	31.5	630656	1013883	7713052	8235788	2594521	1580638	2121204
2009	850000	170000	110500	0	84659	151584	14.9	1932821	32.8	655882	1021041	7755613	8235788	2698302	1677261	2191117
2010	680000	170000	88400	0	88892	151584	15.5	1932821	34.1	682117	1029409	7793585	8235788	2806234	1776825	2256660
2011	510000	170000	66300	0	93336	151584	16.1	1932821	35.4	709402	1039038	7827504	8235788	2918483	1879445	2318013
2012	340000	170000	44200	0	98003	151584	16.8	1932821	36.9	737778	1049981	7857836	8235788	3035223	1985241	2375364
2013	170000	170000	22100	0	102903	151584	17.5	1932821	38.3	767289	1062293	7884993	8235788	3156631	2094339	2428906

CAPITAL COST HYDRO ($)	5100000
LIFETIME (YEARS)	30
RETURN/DISCOUNT RATE	13%
INFLATION RATE	5%
FUEL ESCALATION RATE	5%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH FORK ONLY - 1000 KW INSTALLATION
CASE A - 0 % LOAD GROWTH

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/KWh.)	DIESEL ENERGY	DIESEL (C/KWh.)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	5100000	170000	663000	0	25000	151584	5.6	1932821	12.3	246032	1104032	977020	8235788	1012178	-91854	-81287
1985	4930000	170000	640900	0	26250	151584	5.9	1932821	12.9	258334	1095484	1834944	8235788	1062787	-32697	-106893
1986	4760000	170000	618800	0	27563	151584	6.2	1932821	13.5	271251	1087613	2588715	8235788	1115927	28313	-87270
1987	4590000	170000	596700	0	28941	151584	6.5	1932821	14.2	284813	1080454	3251378	8235788	1171723	91269	-31293
1988	4420000	170000	574600	0	30388	151584	6.8	1932821	14.9	299054	1074042	3834324	8235788	1230309	156268	53522
1989	4250000	170000	552500	0	31907	151584	7.1	1932821	15.7	314007	1068414	4347503	8235788	1291825	223411	160831
1990	4080000	170000	530400	0	33502	151584	7.5	1932821	16.5	329707	1063609	4799602	8235788	1356416	292806	285291
1991	3910000	170000	508300	0	35178	151584	7.9	1932821	17.3	346192	1059670	5198207	8235788	1424237	364567	422427
1992	3740000	170000	486200	0	36936	151584	8.3	1932821	18.2	363502	1056638	5549946	8235788	1495448	438810	568500
1993	3570000	170000	464100	0	38783	151584	8.7	1932821	19.1	381677	1054560	5860607	8235788	1570221	515661	720407
1994	3400000	170000	442000	0	40722	151584	9.1	1932821	20.0	400761	1053483	6135247	8235788	1648732	595249	875587
1995	3230000	170000	419900	0	42758	151584	9.6	1932821	21.0	420799	1053457	6378286	8235788	1731168	677711	1031939
1996	3060000	170000	397800	0	44896	151584	10.1	1932821	22.1	441839	1054535	6593585	8235788	1817727	763192	1187756
1997	2890000	170000	375700	0	47141	151584	10.6	1932821	23.2	463931	1056772	6784519	8235788	1908613	851841	1341664
1998	2720000	170000	353600	0	49498	151584	11.1	1932821	24.3	487127	1060226	6954039	8235788	2004044	943818	1492572
1999	2550000	170000	331500	0	51973	151584	11.6	1932821	25.6	511484	1064957	7104727	8235788	2104246	1039289	1639627
2000	2380000	170000	309400	0	54572	151584	12.2	1932821	26.8	537058	1071030	7238839	8235788	2209458	1138429	1782179
2001	2210000	170000	287300	0	57300	151584	12.8	1932821	28.2	563911	1078511	7358351	8235788	2319931	1241420	1919743
2002	2040000	170000	265200	0	60165	151584	13.5	1932821	29.6	592106	1087472	7464993	8235788	2435928	1348456	2051978
2003	1870000	170000	243100	0	63174	151584	14.2	1932821	31.1	621712	1097985	7560278	8235788	2557724	1459739	2178658
2004	1700000	170000	221000	0	66332	151584	14.9	1932821	32.6	652797	1110130	7645535	8235788	2685610	1575481	2299652
2005	1530000	170000	198900	0	69649	151584	15.6	1932821	34.2	685437	1123986	7721925	8235788	2819891	1695905	2414912
2006	1360000	170000	176800	0	73132	151584	16.4	1932821	36.0	719709	1139640	7790468	8235788	2960886	1821245	2524449
2007	1190000	170000	154700	0	76788	151584	17.2	1932821	37.7	755694	1157182	7852059	8235788	3108930	1951747	2628332
2008	1020000	170000	132600	0	80627	151584	18.1	1932821	39.6	793479	1176707	7907484	8235788	3264376	2087670	2726665
2009	850000	170000	110500	0	84659	151584	19.0	1932821	41.6	833153	1198312	7957433	8235788	3427595	2229283	2819589
2010	680000	170000	88400	0	88892	151584	19.9	1932821	43.7	874811	1222102	8002514	8235788	3598975	2376872	2907266
2011	510000	170000	66300	0	93336	151584	20.9	1932821	45.9	918551	1248188	8043260	8235788	3778924	2530736	2989879
2012	340000	170000	44200	0	98003	151584	22.0	1932821	48.2	964479	1276682	8080141	8235788	3967870	2691188	3067624
2013	170000	170000	22100	0	102903	151584	23.1	1932821	50.6	1012703	1307706	8113573	8235788	4166263	2858557	3140703

CAPITAL COST HYDRO ($) 5100000
LIFETIME (YEARS) 30
RETURN/DISCOUNT RATE 13%
INFLATION RATE 5%
FUEL ESCALATION RATE 6%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH FORK ONLY - 1000 KW INSTALLATION
CASE A - 0 % LOAD GROWTH

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/KWh.)	DIESEL ENERGY	DIESEL (C/KWh.)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	5100000	170000	663000	0	25000	151584	5.6	1932821	12.3	246032	1104032	977020	8235788	1012178	-91854	-81287
1985	4930000	170000	640900	0	26250	151584	5.9	1932821	13.0	260794	1097944	1836871	8235788	1072909	-25035	-100893
1986	4760000	170000	618800	0	27563	151584	6.3	1932821	13.8	276442	1092804	2594240	8235788	1137284	44479	-70067
1987	4590000	170000	596700	0	28941	151584	6.7	1932821	14.6	293029	1088669	3261941	8235788	1205521	116851	1600
1988	4420000	170000	574600	0	30388	151584	7.1	1932821	15.5	310610	1085598	3851160	8235788	1277852	192254	105948
1989	4250000	170000	552500	0	31907	151584	7.5	1932821	16.4	329247	1083654	4371659	8235788	1354523	270869	236052
1990	4080000	170000	530400	0	33502	151584	7.9	1932821	17.4	349002	1082904	4831959	8235788	1435794	352890	386051
1991	3910000	170000	508300	0	35178	151584	8.4	1932821	18.5	369942	1083419	5239498	8235788	1521942	438523	551006
1992	3740000	170000	486200	0	36936	151584	8.9	1932821	19.6	392138	1085275	5600769	8235788	1613259	527984	726764
1993	3570000	170000	464100	0	38783	151584	9.5	1932821	20.8	415667	1088550	5921443	8235788	1710054	621504	909852
1994	3400000	170000	442000	0	40722	151584	10.0	1932821	22.0	440607	1093329	6206471	8235788	1812657	719328	1097379
1995	3230000	170000	419900	0	42758	151584	10.6	1932821	23.3	467043	1099701	6460179	8235788	1921417	821715	1286954
1996	3060000	170000	397800	0	44896	151584	11.3	1932821	24.7	495065	1107762	6686345	8235788	2036702	928940	1476610
1997	2890000	170000	375700	0	47141	151584	11.9	1932821	26.2	524769	1117611	6888271	8235788	2158904	1041293	1664747
1998	2720000	170000	353600	0	49498	151584	12.7	1932821	27.8	556256	1129354	7068844	8235788	2288438	1159084	1850074
1999	2550000	170000	331500	0	51973	151584	13.4	1932821	29.5	589631	1143104	7230589	8235788	2425744	1282640	2031563
2000	2380000	170000	309400	0	54572	151584	14.2	1932821	31.2	625009	1158981	7375714	8235788	2571289	1412308	2208409
2001	2210000	170000	287300	0	57300	151584	15.1	1932821	33.1	662509	1177110	7506152	8235788	2725566	1548457	2379997
2002	2040000	170000	265200	0	60165	151584	16.0	1932821	35.1	702260	1197625	7623596	8235788	2889100	1691475	2545870
2003	1870000	170000	243100	0	63174	151584	16.9	1932821	37.2	744395	1220669	7729529	8235788	3062446	1841777	2705704
2004	1700000	170000	221000	0	66332	151584	18.0	1932821	39.4	789059	1246392	7825250	8235788	3246193	1999801	2859285
2005	1530000	170000	198900	0	69649	151584	19.0	1932821	41.8	836403	1274952	7911900	8235788	3440965	2166013	3006495
2006	1360000	170000	176800	0	73132	151584	20.2	1932821	44.3	886587	1306518	7990479	8235788	3647423	2340904	3147287
2007	1190000	170000	154700	0	76788	151584	21.4	1932821	46.9	939782	1341270	8061869	8235788	3866268	2524998	3281681
2008	1020000	170000	132600	0	80627	151584	22.7	1932821	49.8	996169	1379397	8126841	8235788	4098244	2718847	3409744
2009	850000	170000	110500	0	84659	151584	24.0	1932821	52.7	1055939	1421098	8186077	8235788	4344139	2923041	3531585
2010	680000	170000	88400	0	88892	151584	25.5	1932821	55.9	1119296	1466587	8240176	8235788	4604787	3138200	3647346
2011	510000	170000	66300	0	93336	151584	27.0	1932821	59.3	1186453	1516090	8289667	8235788	4881074	3364984	3757193
2012	340000	170000	44200	0	98003	151584	28.6	1932821	62.8	1257640	1569844	8335018	8235788	5173939	3604095	3861310
2013	170000	170000	22100	0	102903	151584	30.3	1932821	66.6	1333099	1628102	8376640	8235788	5484375	3856273	3959896

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH FORK ONLY - 1000 KW INSTALLATION
CASE A - 0 % LOAD GROWTH

CAPITAL COST HYDRO ($)	5100000
LIFETIME (YEARS)	30
RETURN/DISCOUNT RATE	10%
INFLATION RATE	5%
FUEL ESCALATION RATE	5%

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/KWh.)	DIESEL ENERGY	DIESEL (C/KWh.)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	5100000	170000	510000	0	25000	151584	5.6	1932821	12.3	246032	951032	864575	8235788	1012178	61146	55587
1985	4930000	170000	493000	0	26250	151584	5.9	1932821	12.9	258334	947584	1647702	8235788	1062787	115203	150797
1986	4760000	170000	476000	0	27563	151584	6.2	1932821	13.5	271251	944813	2357554	8235788	1115927	171113	279357
1987	4590000	170000	459000	0	28941	151584	6.5	1932821	14.2	284813	942754	3001468	8235788	1171723	228969	435746
1988	4420000	170000	442000	0	30388	151584	6.8	1932821	14.9	299054	941442	3586029	8235788	1230309	288868	615110
1989	4250000	170000	425000	0	31907	151584	7.1	1932821	15.7	314007	940914	4117150	8235788	1291825	350911	813190
1990	4080000	170000	408000	0	33502	151584	7.5	1932821	16.5	329707	941209	4600139	8235788	1356416	415206	1026256
1991	3910000	170000	391000	0	35178	151584	7.9	1932821	17.3	346192	942370	5039762	8235788	1424237	481867	1251051
1992	3740000	170000	374000	0	36936	151584	8.3	1932821	18.2	363502	944438	5440296	8235788	1495448	551010	1484733
1993	3570000	170000	357000	0	38783	151584	8.7	1932821	19.1	381677	947460	5805583	8235788	1570221	622761	1724834
1994	3400000	170000	340000	0	40722	151584	9.1	1932821	20.0	400761	951483	6139072	8235788	1648732	697249	1969215
1995	3230000	170000	323000	0	42758	151584	9.6	1932821	21.0	420799	956557	6443861	8235788	1731168	774611	2216030
1996	3060000	170000	306000	0	44896	151584	10.1	1932821	22.1	441839	962735	6722731	8235788	1817727	854992	2463691
1997	2890000	170000	289000	0	47141	151584	10.6	1932821	23.2	463931	970072	6978181	8235788	1908613	938541	2710838
1998	2720000	170000	272000	0	49498	151584	11.1	1932821	24.3	487127	978626	7212456	8235788	2004044	1025418	2956315
1999	2550000	170000	255000	0	51973	151584	11.6	1932821	25.6	511484	988457	7427573	8235788	2104246	1115789	3199143
2000	2380000	170000	238000	0	54572	151584	12.2	1932821	26.8	537058	999630	7625345	8235788	2209458	1209829	3438502
2001	2210000	170000	221000	0	57300	151584	12.8	1932821	28.2	563911	1012211	7807400	8235788	2319931	1307720	3673706
2002	2040000	170000	204000	0	60165	151584	13.5	1932821	29.6	592106	1026272	7975203	8235788	2435928	1409656	3904197
2003	1870000	170000	187000	0	63174	151584	14.2	1932821	31.1	621712	1041885	8130073	8235788	2557724	1515839	4129516
2004	1700000	170000	170000	0	66332	151584	14.9	1932821	32.6	652797	1059130	8273194	8235788	2685610	1626481	4349304
2005	1530000	170000	153000	0	69649	151584	15.6	1932821	34.2	685437	1078086	8405632	8235788	2819891	1741805	4563277
2006	1360000	170000	136000	0	73132	151584	16.4	1932821	36.0	719709	1098840	8528349	8235788	2960886	1862045	4771227
2007	1190000	170000	119000	0	76788	151584	17.2	1932821	37.7	755694	1121482	8642208	8235788	3108930	1987447	4973004
2008	1020000	170000	102000	0	80627	151584	18.1	1932821	39.6	793479	1146107	8747989	8235788	3264376	2118270	5168512
2009	850000	170000	85000	0	84659	151584	19.0	1932821	41.6	833153	1172812	8846394	8235788	3427595	2254783	5357700
2010	680000	170000	68000	0	88892	151584	19.9	1932821	43.7	874811	1201702	8938057	8235788	3598975	2397272	5540559
2011	510000	170000	51000	0	93336	151584	20.9	1932821	45.9	918551	1232888	9023550	8235788	3778924	2546036	5717109
2012	340000	170000	34000	0	98003	151584	22.0	1932821	48.2	964479	1266482	9103388	8235788	3967870	2701388	5887403
2013	170000	170000	17000	0	102903	151584	23.1	1932821	50.6	1012703	1302606	9178039	8235788	4166263	2863657	6051515

ECONOMIC ANALYSIS

NORTH FORK 1000 kW INSTALLATION
CASE B LOAD GROWTH

Page	Return/Discount Rate	Inflation Rate	Fuel Escalation Rate
B-14	13%	5%	4%
B-15	13%	5%	5%
B-16	13%	5%	6%
B-17	10%	5%	5%

27-Mar-85

CAPITAL COST HYDRO ($)	5100000
LIFETIME (YEARS)	30
RETURN/DISCOUNT RATE	13%
INFLATION RATE	5%
FUEL ESCALATION RATE	4%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH FORK ONLY - 1000 kW INSTALLATION
CASE B - 1.6% LOAD GROWTH

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/KWh.)	DIESEL ENERGY	DIESEL (C/KWh.)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	5100000	170000	663000	0	25000	151584	5.6	1932821	12.3	246032	1104032	977020	8235788	1012178	-91854	-81287
1985	4930000	170000	640900	0	26250	136785	5.8	2064625	12.8	271858	1109008	1845536	8369557	1069763	-39245	-112021
1986	4760000	170000	618800	0	27563	125891	6.1	2198538	13.3	299874	1116236	2619144	8503470	1130355	14118	-102237
1987	4590000	170000	596700	0	28941	118424	6.3	2334593	13.8	330207	1125848	3309648	8639525	1194378	68530	-60206
1988	4420000	170000	574600	0	30388	110816	6.6	2472826	14.4	362792	1137779	3927189	8777758	1262028	124248	7231
1989	4250000	170000	552500	0	31907	103065	6.8	2613270	15.0	397775	1152183	4480603	8918202	1333509	181326	94325
1990	4080000	170000	530400	0	33502	95167	7.1	2755961	15.6	435316	1169219	4977592	9060893	1409039	239820	196263
1991	3910000	170000	508300	0	35178	87120	7.4	2900935	16.2	475583	1189060	5424869	9205867	1488847	299787	309031
1992	3740000	170000	486200	0	36936	78921	7.7	3048229	16.8	518752	1211888	5828288	9353161	1573175	361287	429298
1993	3570000	170000	464100	0	38783	70569	8.0	3197880	17.5	565014	1237897	6192958	9502812	1662280	424382	554316
1994	3400000	170000	442000	0	40722	62061	8.3	3349925	18.2	614569	1267292	6523338	9654857	1756431	489139	681833
1995	3230000	170000	419900	0	42758	53392	8.6	3504402	18.9	667632	1300291	6823323	9809334	1855915	555625	810019
1996	3060000	170000	397800	0	44896	44562	9.0	3661352	19.7	724428	1337124	7096316	9966284	1961034	623910	937399
1997	2890000	170000	375700	0	47141	35567	9.3	3820812	20.5	785198	1378039	7345296	10125744	2072107	694068	1062801
1998	2720000	170000	353600	0	49498	26405	9.7	3982824	21.3	850197	1423296	7572867	10287756	2189471	766176	1185306
1999	2550000	170000	331500	0	51973	17072	10.1	4147428	22.1	919697	1473170	7781315	10452360	2313483	840313	1304207
2000	2380000	170000	309400	0	54572	7565	10.5	4314666	23.0	993984	1527956	7972643	10619598	2444519	916563	1418977
2001	2210000	170000	287300	0	57300	0	10.9	4484580	23.9	1073595	1588195	8148634	10789512	2582976	994781	1529211
2002	2040000	170000	265200	0	60165	0	11.3	4657212	24.9	1159519	1654885	8310919	10962144	2729276	1074391	1634570
2003	1870000	170000	243100	0	63174	0	11.8	4832606	25.9	1251315	1727589	8460843	11137538	2883862	1156273	1734914
2004	1700000	170000	221000	0	66332	0	12.3	5010807	26.9	1349355	1806688	8599594	11315739	3047204	1240517	1830184
2005	1530000	170000	198900	0	69649	0	12.8	5191858	28.0	1454035	1892584	8728220	11496790	3219798	1327214	1920386
2006	1360000	170000	176800	0	73132	0	13.3	5375807	29.1	1565774	1985705	8847649	11680739	3402167	1416462	2005578
2007	1190000	170000	154700	0	76788	0	13.8	5562699	30.3	1685017	2086505	8958704	11867631	3594866	1508361	2085861
2008	1020000	170000	132600	0	80627	0	14.4	5752581	31.5	1812236	2195464	9062115	12057513	3798479	1603016	2161366
2009	850000	170000	110500	0	84659	0	14.9	5945501	32.8	1947932	2313091	9158532	12250433	4013625	1700534	2232250
2010	680000	170000	88400	0	88892	0	15.5	6141508	34.1	2092636	2439928	9248535	12446440	4240957	1801029	2298685
2011	510000	170000	66300	0	93336	0	16.1	6340651	35.4	2246911	2576548	9332644	12645583	4481165	1904617	2360860
2012	340000	170000	44200	0	98003	0	16.8	6542981	36.9	2411354	2723557	9411323	12847913	4734978	2011420	2418967
2013	170000	170000	22100	0	102903	0	17.5	6748547	38.3	2586598	2881602	9484992	13053479	5003167	2121565	2473205

27-Mar-85

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH FORK ONLY - 1000 kW INSTALLATION
CASE B - 1.6% LOAD GROWTH

CAPITAL COST HYDRO ($)	5100000
LIFETIME (YEARS)	30
RETURN/DISCOUNT RATE	13%
INFLATION RATE	5%
FUEL ESCALATION RATE	5%

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/KWh.)	DIESEL ENERGY	DIESEL (C/KWh.)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	5100000	170000	663000	0	25000	151584	5.6	1932821	12.3	246032	1104032	977020	8235788	1012178	-91854	-81287
1985	4930000	170000	640900	0	26250	136785	5.9	2064625	12.9	274472	1111622	1847583	8369557	1080049	-31573	-106013
1986	4760000	170000	618800	0	27563	125891	6.2	2198538	13.5	305668	1122031	2625207	8503470	1152197	30166	-85107
1987	4590000	170000	596700	0	28941	118424	6.5	2334593	14.2	339825	1135465	3321609	8639525	1229163	93698	-27640
1988	4420000	170000	574600	0	30388	110816	6.8	2472826	14.9	376948	1151936	3946833	8777758	1311272	159336	58842
1989	4250000	170000	552500	0	31907	103065	7.1	2613270	15.7	417271	1171678	4509612	8918202	1398865	227187	167964
1990	4080000	170000	530400	0	33502	95167	7.5	2755961	16.5	461042	1194945	5017536	9060893	1492309	297364	294361
1991	3910000	170000	508300	0	35178	87120	7.9	2900935	17.3	508531	1222009	5477207	9205867	1591995	369986	433535
1992	3740000	170000	486200	0	36936	78921	8.3	3048229	18.2	560025	1253161	5894365	9353161	1698340	445179	581729
1993	3570000	170000	464100	0	38783	70569	8.7	3197880	19.1	615833	1288716	6274006	9502812	1811789	523073	735820
1994	3400000	170000	442000	0	40722	62061	9.1	3349925	20.0	676286	1329009	6620475	9654857	1932817	603808	893231
1995	3230000	170000	419900	0	42758	53392	9.6	3504402	21.0	741742	1374400	6937557	9809334	2061929	687529	1051848
1996	3060000	170000	397800	0	44896	44562	10.1	3661352	22.1	812581	1425278	7228548	9966284	2199666	774388	1209951
1997	2890000	170000	375700	0	47141	35567	10.6	3820812	23.2	889215	1482056	7496321	10125744	2346604	864548	1366154
1998	2720000	170000	353600	0	49498	26405	11.1	3982824	24.3	972083	1545181	7743381	10287756	2503357	958176	1519358
1999	2550000	170000	331500	0	51973	17072	11.6	4147428	25.6	1061657	1615130	7971916	10452360	2670581	1055451	1668700
2000	2380000	170000	309400	0	54572	7565	12.2	4314666	26.8	1158443	1692415	8183837	10619598	2848976	1156561	1813522
2001	2210000	170000	287300	0	57300	0	12.8	4484580	28.2	1263257	1777857	8380845	10789512	3039287	1261430	1953304
2002	2040000	170000	265200	0	60165	0	13.5	4657212	29.6	1377480	1872845	8564504	10962144	3242312	1369466	2087600
2003	1870000	170000	243100	0	63174	0	14.2	4832606	31.1	1500825	1977098	8736081	11137538	3458898	1481800	2216194
2004	1700000	170000	221000	0	66332	0	14.9	5010807	32.6	1633975	2091308	8896690	11315739	3689952	1598645	2338967
2005	1530000	170000	198900	0	69649	0	15.6	5191858	34.2	1777665	2216214	9047312	11496790	3936441	1720227	2455879
2006	1360000	170000	176800	0	73132	0	16.4	5375807	36.0	1932681	2352612	9188808	11680739	4199396	1846783	2566953
2007	1190000	170000	154700	0	76788	0	17.2	5562699	37.7	2099865	2501353	9321943	11867631	4479915	1978562	2672262
2008	1020000	170000	132600	0	80627	0	18.1	5752581	39.6	2280121	2663348	9447392	12057513	4779174	2115826	2771922
2009	850000	170000	110500	0	84659	0	19.0	5945501	41.6	2474417	2839576	9565755	12250433	5098422	2258847	2866078
2010	680000	170000	88400	0	88892	0	19.9	6141508	43.7	2683791	3031083	9677564	12446440	5438997	2407914	2954900
2011	510000	170000	66300	0	93336	0	20.9	6340651	45.9	2909356	3238992	9783298	12645583	5802322	2563330	3038578
2012	340000	170000	44200	0	98003	0	22.0	6542981	48.2	3152303	3464506	9883382	12847913	6189917	2725411	3117311
2013	170000	170000	22100	0	102903	0	23.1	6748547	50.6	3413908	3708912	9978201	13053479	6603404	2894492	3191309

CAPITAL COST HYDRO ($)	5100000
LIFETIME (YEARS)	30
RETURN/DISCOUNT RATE	13%
INFLATION RATE	5%
FUEL ESCALATION RATE	6%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH FORK ONLY - 1000 kW INSTALLATION
CASE B - 1.6% LOAD GROWTH

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/KWh.)	DIESEL ENERGY	DIESEL (C/KWh.)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	5100000	170000	663000	0	25000	151584	5.6	1932821	12.3	246032	1104032	977020	8235788	1012178	-91854	-81287
1985	4930000	170000	640900	0	26250	136785	5.9	2064625	13.0	277086	1114236	1849630	8369557	1090336	-23901	-100005
1986	4760000	170000	618800	0	27563	125891	6.3	2198538	13.8	311518	1127881	2631308	8503470	1174248	46367	-67870
1987	4590000	170000	596700	0	28941	118424	6.7	2334593	14.6	349627	1145267	3333722	8639525	1264618	119351	5330
1988	4420000	170000	574600	0	30388	110816	7.1	2472826	15.5	391514	1166502	3966853	8777758	1361943	195441	111408
1989	4250000	170000	552500	0	31907	103065	7.5	2613270	16.4	437523	1191930	4539359	8918202	1466758	274828	243413
1990	4080000	170000	530400	0	33502	95167	7.9	2755961	17.4	488023	1221925	5058751	9060893	1579640	357714	395463
1991	3910000	170000	508300	0	35178	87120	8.4	2900935	18.5	543417	1256895	5531545	9205867	1701209	444314	562596
1992	3740000	170000	486200	0	36936	78921	8.9	3048229	19.6	604143	1297280	5963389	9353161	1832134	534854	740641
1993	3570000	170000	464100	0	38783	70569	9.5	3197880	20.8	670675	1343558	6359186	9502812	1973135	629577	926107
1994	3400000	170000	442000	0	40722	62061	10.0	3349925	22.0	743526	1396249	6723184	9654857	2124987	728739	1116088
1995	3230000	170000	419900	0	42758	53392	10.6	3504402	23.3	823256	1455915	7059073	9809334	2288526	832612	1308176
1996	3060000	170000	397800	0	44896	44562	11.3	3661352	24.7	910470	1523166	7370049	9966284	2464651	941485	1500394
1997	2890000	170000	375700	0	47141	35567	11.9	3820812	26.2	1005824	1598665	7658890	10125744	2654331	1055666	1691128
1998	2720000	170000	353600	0	49498	26405	12.7	3982824	27.8	1110031	1683129	7928007	10287756	2858608	1175479	1879076
1999	2550000	170000	331500	0	51973	17072	13.4	4147428	29.5	1223862	1777335	8179493	10452360	3078607	1301271	2063201
2000	2380000	170000	309400	0	54572	7565	14.2	4314666	31.2	1348155	1882127	8415169	10619598	3315536	1433410	2242690
2001	2210000	170000	287300	0	57300	0	15.1	4484580	33.1	1484135	1998735	8636654	10789512	3570700	1571965	2416883
2002	2040000	170000	265200	0	60165	0	16.0	4657212	35.1	1633742	2129107	8845443	10962144	3845501	1716394	2585199
2003	1870000	170000	243100	0	63174	0	16.9	4832606	37.2	1796986	2273260	9042721	11137538	4141451	1868191	2747325
2004	1700000	170000	221000	0	66332	0	18.0	5010807	39.4	1975044	2432377	9229524	11315739	4460177	2027800	2903057
2005	1530000	170000	198900	0	69649	0	19.0	5191858	41.8	2169192	2607741	9406755	11496790	4803432	2195692	3052284
2006	1360000	170000	176800	0	73132	0	20.2	5375807	44.3	2380809	2800741	9575204	11680739	5173104	2372364	3194968
2007	1190000	170000	154700	0	76788	0	21.4	5562699	46.9	2611394	3012882	9735565	11867631	5571227	2558345	3331137
2008	1020000	170000	132600	0	80627	0	22.7	5752581	49.8	2862565	3245793	9888448	12057513	5999988	2754195	3460865
2009	850000	170000	110500	0	84659	0	24.0	5945501	52.7	3136079	3501238	10034391	12250433	6461747	2960509	3584268
2010	680000	170000	88400	0	88892	0	25.5	6141508	55.9	3433835	3781127	10173868	12446440	6959043	3177917	3701494
2011	510000	170000	66300	0	93336	0	27.0	6340651	59.3	3757890	4087527	10307301	12645583	7494611	3407084	3812715
2012	340000	170000	44200	0	98003	0	28.6	6542981	62.8	4110472	4422676	10435066	12847913	8071397	3648721	3918121
2013	170000	170000	22100	0	102903	0	30.3	6748547	66.6	4493992	4788995	10557497	13053479	8692571	3903576	4017916

CAPITAL COST HYDRO ($) 5100000
LIFETIME (YEARS) 30
RETURN/DISCOUNT RATE 10%
INFLATION RATE 5%
FUEL ESCALATION RATE 5%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH FORK ONLY - 1000 kW INSTALLATION
CASE B - 1.6% LOAD GROWTH

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/KWh.)	DIESEL ENERGY	DIESEL (C/KWh.)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	5100000	170000	510000	0	25000	151584	5.6	1932821	12.3	246032	951032	864575	8235788	1012178	61146	55587
1985	4930000	170000	493000	0	26250	136785	5.9	2064625	12.9	274472	963722	1661040	8369557	1080049	116327	151725
1986	4760000	170000	476000	0	27563	125891	6.2	2198538	13.5	305668	979231	2396750	8503470	1152197	172966	281677
1987	4590000	170000	459000	0	28941	118424	6.5	2334593	14.2	339825	997765	3078237	8639525	1229163	231398	439725
1988	4420000	170000	442000	0	30388	110816	6.8	2472826	14.9	376948	1019336	3711165	8777758	1311272	291936	620995
1989	4250000	170000	425000	0	31907	103065	7.1	2613270	15.7	417271	1044178	4300576	8918202	1398865	354687	821206
1990	4080000	170000	408000	0	33502	95167	7.5	2755961	16.5	461042	1072545	4850961	9060893	1492309	419764	1036611
1991	3910000	170000	391000	0	35178	87120	7.9	2900935	17.3	508531	1104709	5366315	9205867	1591995	487286	1263934
1992	3740000	170000	374000	0	36936	78921	8.3	3048229	18.2	560025	1140961	5850194	9353161	1698340	557379	1500317
1993	3570000	170000	357000	0	38783	70569	8.7	3197880	19.1	615833	1181616	6305759	9502812	1811789	630173	1743276
1994	3400000	170000	340000	0	40722	62061	9.1	3349925	20.0	676286	1227009	6735818	9654857	1932817	705808	1990658
1995	3230000	170000	323000	0	42758	53392	9.6	3504402	21.0	741742	1277500	7142869	9809334	2061929	784429	2240601
1996	3060000	170000	306000	0	44896	44562	10.1	3661352	22.1	812581	1333478	7529130	9966284	2199666	866188	2491505
1997	2890000	170000	289000	0	47141	35567	10.6	3820812	23.2	889215	1395356	7896570	10125744	2346604	951248	2741998
1998	2720000	170000	272000	0	49498	26405	11.1	3982824	24.3	972083	1463581	8246940	10287756	2503357	1039776	2990912
1999	2550000	170000	255000	0	51973	17072	11.6	4147428	25.6	1061657	1538630	8581791	10452360	2670581	1131951	3237257
2000	2380000	170000	238000	0	54572	7565	12.2	4314666	26.8	1158443	1621015	8902500	10619598	2848976	1227961	3480203
2001	2210000	170000	221000	0	57300	0	12.8	4484580	28.2	1263257	1711557	9210339	10789512	3039287	1327730	3719007
2002	2040000	170000	204000	0	60165	0	13.5	4657212	29.6	1377480	1811645	9506557	10962144	3242312	1430666	3952932
2003	1870000	170000	187000	0	63174	0	14.2	4832606	31.1	1500825	1920998	9792101	11137538	3458898	1537900	4181531
2004	1700000	170000	170000	0	66332	0	14.9	5010807	32.6	1633975	2040308	10067809	11315739	3689952	1649645	4404449
2005	1530000	170000	153000	0	69649	0	15.6	5191858	34.2	1777665	2170314	10334424	11496790	3936441	1766127	4621410
2006	1360000	170000	136000	0	73132	0	16.4	5375807	36.0	1932681	2311812	10592602	11680739	4199396	1887583	4832212
2007	1190000	170000	119000	0	76788	0	17.2	5562699	37.7	2099865	2465653	10842929	11867631	4479915	2014262	5036711
2008	1020000	170000	102000	0	80627	0	18.1	5752581	39.6	2280121	2632748	11085921	12057513	4779174	2146426	5234818
2009	850000	170000	85000	0	84659	0	19.0	5945501	41.6	2474417	2814076	11322038	12250433	5098422	2284347	5426487
2010	680000	170000	68000	0	88892	0	19.9	6141508	43.7	2683791	3010683	11551686	12446440	5438997	2428314	5611713
2011	510000	170000	51000	0	93336	0	20.9	6340651	45.9	2909356	3223692	11775227	12645583	5802322	2578630	5790524
2012	340000	170000	34000	0	98003	0	22.0	6542981	48.2	3152303	3454306	11992985	12847913	6189917	2735611	5962975
2013	170000	170000	17000	0	102903	0	23.1	6748547	50.6	3413908	3703812	12205245	13053479	6603404	2899592	6129147

ECONOMIC ANALYSIS

NORTH FORK 1000 kW INSTALLATION
CASE C

Page	Return/Discount Rate	Inflation Rate	Fuel Escalation Rate
B-19	13%	5%	4%
B-20	13%	5%	5%
B-21	13%	5%	6%
B-22	10%	5%	5%

27-Mar-85

CAPITAL COST HYDRO ($)	5100000
LIFETIME (YEARS)	30
RETURN/DISCOUNT RATE	13%
INFLATION RATE	5%
FUEL ESCALATION RATE	4%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH FORK ONLY - 1000 kW INSTALLATION
CASE C - 70 kW ADDED TO YEARLY PEAK

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/kW.h)	DIESEL ENERGY	DIESEL (C/kW.h)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	5100000	170000	663000	0	25000	151584	5.6	1932821	12.3	246032	1104032	977020	8235788	1012178	-91854	-81287
1985	4930000	170000	640900	0	26250	159709	5.8	2334371	12.8	307671	1144821	1873583	8703139	1112400	-32421	-106677
1986	4760000	170000	618800	0	27563	106867	6.1	2735921	13.3	370155	1186518	2695899	9107671	1210670	24153	-89938
1987	4590000	170000	596700	0	28941	58063	6.3	3137471	13.8	437400	1233040	3452146	9512203	1315022	81982	-39657
1988	4420000	170000	574600	0	30388	30658	6.6	3539021	14.4	510833	1285821	4150038	9916736	1425785	139964	36310
1989	4250000	170000	552500	0	31907	3275	6.8	3940571	15.0	589443	1343850	4795514	10321268	1543304	199454	132111
1990	4080000	170000	530400	0	33502	0	7.1	4342121	15.6	675233	1409136	5394482	10725800	1667945	258809	242121
1991	3910000	170000	508300	0	35178	0	7.4	4743671	16.2	767184	1480662	5951448	11130332	1800086	319425	362275
1992	3740000	170000	486200	0	36936	0	7.7	5145221	16.8	865411	1558548	6470265	11534864	1940131	381583	489299
1993	3570000	170000	464100	0	38783	0	8.0	5546770	17.5	970269	1643152	6954318	11939396	2088499	445347	620493
1994	3400000	170000	442000	0	40722	0	8.3	5948320	18.2	1082130	1734853	7406590	12343928	2245632	510780	753652
1995	3230000	170000	419900	0	42758	0	8.6	6349870	18.9	1201389	1834047	7829716	12748460	2411995	577948	886988
1996	3060000	170000	397800	0	44896	0	9.0	6751420	19.7	1328456	1941152	8226030	13152993	2588073	646921	1019066
1997	2890000	170000	375700	0	47141	0	9.3	7152970	20.5	1463766	2056607	8597611	13557525	2774378	717771	1148750
1998	2720000	170000	353600	0	49498	0	9.7	7554520	21.3	1607776	2180874	8946313	13962057	2971447	790573	1275156
1999	2550000	170000	331500	0	51973	0	10.1	7956070	22.1	1760964	2314438	9273797	14366589	3179843	865405	1397607
2000	2380000	170000	309400	0	54572	0	10.5	8357620	23.0	1923836	2457807	9581558	14771121	3400155	942348	1515606
2001	2210000	170000	287300	0	57300	0	10.9	8759170	23.9	2096919	2611519	9870947	15175653	3633005	1021486	1628799
2002	2040000	170000	265200	0	60165	0	11.3	9160720	24.9	2280771	2776136	10143186	15580185	3879043	1102907	1736955
2003	1870000	170000	243100	0	63174	0	11.8	9562270	25.9	2475976	2952249	10399389	15984717	4138951	1186702	1839939
2004	1700000	170000	221000	0	66332	0	12.3	9963820	26.9	2683148	3140480	10640573	16389249	4413445	1272965	1937701
2005	1530000	170000	198900	0	69649	0	12.8	10365370	28.0	2902932	3341481	10867671	16793782	4703276	1361796	2030253
2006	1360000	170000	176800	0	73132	0	13.3	10766920	29.1	3136006	3555937	11081541	17198314	5009233	1453296	2117661
2007	1190000	170000	154700	0	76788	0	13.8	11168470	30.3	3383081	3784569	11282975	17602846	5332140	1547571	2200031
2008	1020000	170000	132600	0	80627	0	14.4	11570020	31.5	3644904	4028132	11472708	18007378	5672866	1644734	2277501
2009	850000	170000	110500	0	84659	0	14.9	11971570	32.8	3922261	4287420	11651421	18411910	6032318	1744898	2350234
2010	680000	170000	88400	0	88892	0	15.5	12373120	34.1	4215974	4563266	11819750	18816442	6411449	1848183	2418409
2011	510000	170000	66300	0	93336	0	16.1	12774670	35.4	4526909	4856545	11978287	19220974	6811260	1954715	2482219
2012	340000	170000	44200	0	98003	0	16.8	13176220	36.9	4855973	5168176	12127588	19625506	7232797	2064621	2541863
2013	170000	170000	22100	0	102903	0	17.5	13577770	38.3	5204118	5499122	12268173	20030039	7677159	2178037	2597544

CAPITAL COST HYDRO ($) 5100000
LIFETIME (YEARS) 30
RETURN/DISCOUNT RATE 13%
INFLATION RATE 5%
FUEL ESCALATION RATE 5%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH FORK ONLY - 1000 kW INSTALLATION
CASE C - 70 kW ADDED TO YEARLY PEAK

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/kW.h)	DIESEL ENERGY	DIESEL (C/kW.h)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	5100000	170000	663000	0	25000	151584	5.6	1932821	12.3	246032	1104032	977020	8235788	1012178	-91854	-81287
1985	4930000	170000	640900	0	26250	159709	5.9	2334371	12.9	310630	1147780	1875900	8703139	1123097	-24683	-100617
1986	4760000	170000	618800	0	27563	106867	6.2	2735921	13.5	377308	1193670	2703173	9107671	1234064	40394	-72622
1987	4590000	170000	596700	0	28941	58063	6.5	3137471	14.2	450139	1245779	3467233	9512203	1353321	107542	-6665
1988	4420000	170000	574600	0	30388	30658	6.8	3539021	14.9	530766	1305754	4175944	9916736	1481419	175665	88679
1989	4250000	170000	552500	0	31907	3275	7.1	3940571	15.7	618332	1372739	4835296	10321268	1618942	246203	206935
1990	4080000	170000	530400	0	33502	0	7.5	4342121	16.5	715138	1449040	5451226	10725800	1766515	317475	341882
1991	3910000	170000	508300	0	35178	0	7.9	4743671	17.3	820335	1533813	6028184	11130332	1924798	390985	488954
1992	3740000	170000	486200	0	36936	0	8.3	5145221	18.2	934265	1627402	6569922	11534864	2094492	467090	644442
1993	3570000	170000	464100	0	38783	0	8.7	5546770	19.1	1057537	1730421	7079684	11939396	2276344	545924	805264
1994	3400000	170000	442000	0	40722	0	9.1	5948320	20.0	1190801	1843523	7560286	12343928	2471145	627622	968884
1995	3230000	170000	419900	0	42758	0	9.6	6349870	21.0	1334747	1967406	8014178	12748460	2679735	712330	1133222
1996	3060000	170000	397800	0	44896	0	10.1	6751420	22.1	1490111	2102807	8443497	13152993	2903007	800199	1296595
1997	2890000	170000	375700	0	47141	0	10.6	7152970	23.2	1657674	2250516	8850112	13557525	3141906	891390	1457648
1998	2720000	170000	353600	0	49498	0	11.1	7554520	24.3	1838269	2411367	9235667	13962057	3397437	986071	1615312
1999	2550000	170000	331500	0	51973	0	11.6	7956070	25.6	2032778	2586251	9601612	14366589	3670667	1084416	1768752
2000	2380000	170000	309400	0	54572	0	12.2	8357620	26.8	2242143	2776115	9949231	14771121	3962727	1186612	1917338
2001	2210000	170000	287300	0	57300	0	12.8	8759170	28.2	2467362	2981963	10279670	15175653	4274815	1292853	2060602
2002	2040000	170000	265200	0	60165	0	13.5	9160720	29.6	2709498	3204864	10593951	15580185	4608206	1403342	2198219
2003	1870000	170000	243100	0	63174	0	14.2	9562270	31.1	2969679	3445953	10892999	15984717	4964249	1518295	2329980
2004	1700000	170000	221000	0	66332	0	14.9	9963820	32.6	3249105	3706437	11177648	16389249	5344375	1637938	2455771
2005	1530000	170000	198900	0	69649	0	15.6	10365370	34.2	3549049	3987598	11448658	16793782	5750104	1762506	2575557
2006	1360000	170000	176800	0	73132	0	16.4	10766920	36.0	3870864	4290796	11706726	17198314	6183044	1892248	2689365
2007	1190000	170000	154700	0	76788	0	17.2	11168470	37.7	4215989	4617477	11952492	17602846	6644903	2027426	2797275
2008	1020000	170000	132600	0	80627	0	18.1	11570020	39.6	4585949	4969176	12186550	18007378	7137490	2168314	2899407
2009	850000	170000	110500	0	84659	0	19.0	11971570	41.6	4982364	5347523	12409451	18411910	7662724	2315201	2995912
2010	680000	170000	88400	0	88892	0	19.9	12373120	43.7	5406957	5754248	12621713	18816442	8222638	2468390	3086965
2011	510000	170000	66300	0	93336	0	20.9	12774670	45.9	5861552	6191189	12823818	19220974	8819386	2628197	3172760
2012	340000	170000	44200	0	98003	0	22.0	13176220	48.2	6348090	6660294	13016224	19625506	9455252	2794959	3253502
2013	170000	170000	22100	0	102903	0	23.1	13577770	50.6	6868628	7163632	13199362	20030039	10132657	2969025	3329406

CAPITAL COST HYDRO ($)	5100000
LIFETIME (YEARS)	30
RETURN/DISCOUNT RATE	13%
INFLATION RATE	5%
FUEL ESCALATION RATE	6%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH FORK ONLY - 1000 kW INSTALLATION
CASE C - 70 kW ADDED TO YEARLY PEAK

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/kW.h)	DIESEL ENERGY	DIESEL (C/kW.h)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	5100000	170000	663000	0	25000	151584	5.6	1932821	12.3	246032	1104032	977020	8235788	1012178	-91854	-81287
1985	4930000	170000	640900	0	26250	159709	5.9	2334371	13.0	313588	1150738	1878217	8703139	1133793	-16945	-94557
1986	4760000	170000	618800	0	27563	106867	6.3	2735921	13.8	384529	1200891	2710494	9107671	1257682	56791	-55198
1987	4590000	170000	596700	0	28941	58063	6.7	3137471	14.6	463123	1258763	3482518	9512203	1392357	133594	26737
1988	4420000	170000	574600	0	30388	30658	7.1	3539021	15.5	551276	1326264	4202360	9916736	1538665	212401	142020
1989	4250000	170000	552500	0	31907	3275	7.5	3940571	16.4	648343	1402750	4876127	10321268	1697517	294768	283602
1990	4080000	170000	530400	0	33502	0	7.9	4342121	17.4	756988	1490890	5509846	10725800	1869893	379003	444701
1991	3910000	170000	508300	0	35178	0	8.4	4743671	18.5	876612	1590090	6107974	11130332	2056843	466753	620275
1992	3740000	170000	486200	0	36936	0	8.9	5145221	19.6	1007866	1701002	6674212	11534864	2259494	558492	806189
1993	3570000	170000	464100	0	38783	0	9.5	5546770	20.8	1151715	1824598	7211717	11939396	2479060	654462	998986
1994	3400000	170000	442000	0	40722	0	10.0	5948320	22.0	1309197	1961919	7723185	12343928	2716839	754920	1195791
1995	3230000	170000	419900	0	42758	0	10.6	6349870	23.3	1481430	2114089	8210918	12748460	2974227	860138	1394230
1996	3060000	170000	397800	0	44896	0	11.3	6751420	24.7	1669619	2282316	8676885	13152993	3252721	970406	1592353
1997	2890000	170000	375700	0	47141	0	11.9	7152970	26.2	1875057	2467899	9122777	13557525	3553927	1086029	1788573
1998	2720000	170000	353600	0	49498	0	12.7	7554520	27.8	2099138	2672236	9550043	13962057	3879568	1207332	1981614
1999	2550000	170000	331500	0	51973	0	13.4	7956070	29.5	2343357	2896830	9959933	14366589	4231492	1334662	2170464
2000	2380000	170000	309400	0	54572	0	14.2	8357620	31.2	2609326	3143298	10353530	14771121	4611680	1468382	2354331
2001	2210000	170000	287300	0	57300	0	15.1	8759170	33.1	2898775	3413376	10731774	15175653	5022258	1608882	2532615
2002	2040000	170000	265200	0	60165	0	16.0	9160720	35.1	3213565	3708930	11095487	15580185	5465502	1756572	2704872
2003	1870000	170000	243100	0	63174	0	16.9	9562270	37.2	3555694	4031967	11445390	15984717	5943856	1911889	2870790
2004	1700000	170000	221000	0	66332	0	18.0	9963820	39.4	3927309	4384641	11782124	16389249	6459937	2075295	3030169
2005	1530000	170000	198900	0	69649	0	19.0	10365370	41.8	4330718	4769267	12106259	16793782	7016549	2247282	3182902
2006	1360000	170000	176800	0	73132	0	20.2	10766920	44.3	4768397	5188329	12418308	17198314	7616699	2428370	3328955
2007	1190000	170000	154700	0	76788	0	21.4	11168470	46.9	5243007	5644496	12718738	17602846	8263607	2619112	3468358
2008	1020000	170000	132600	0	80627	0	22.7	11570020	49.8	5757405	6140632	13007974	18007378	8960725	2820092	3601190
2009	850000	170000	110500	0	84659	0	24.0	11971570	52.7	6314655	6679814	13286409	18411910	9711747	3031933	3727570
2010	680000	170000	88400	0	88892	0	25.5	12373120	55.9	6918049	7265340	13554411	18816442	10520633	3255293	3847651
2011	510000	170000	66300	0	93336	0	27.0	12774670	59.3	7571117	7900753	13812324	19220974	11391624	3490871	3961607
2012	340000	170000	44200	0	98003	0	28.6	13176220	62.8	8277648	8589851	14060472	19625506	12329259	3739408	4069633
2013	170000	170000	22100	0	102903	0	30.3	13577770	66.6	9041707	9336710	14299165	20030039	13338401	4001690	4171936

CAPITAL COST HYDRO ($)	5100000
LIFETIME (YEARS)	30
RETURN/DISCOUNT RATE	10%
INFLATION RATE	5%
FUEL ESCALATION RATE	5%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH FORK ONLY - 1000 kW INSTALLATION
CASE C - 70 kW ADDED TO YEARLY PEAK

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/kW.h)	DIESEL ENERGY	DIESEL (C/kW.h)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	5100000	170000	510000	0	25000	151584	5.6	1932821	12.3	246032	951032	864575	8235788	1012178	61146	55587
1985	4930000	170000	493000	0	26250	159709	5.9	2334371	12.9	310630	999880	1690922	8703139	1123097	123217	157419
1986	4760000	170000	476000	0	27563	106867	6.2	2735921	13.5	377308	1050870	2480456	9107671	1234064	183194	295056
1987	4590000	170000	459000	0	28941	58063	6.5	3137471	14.2	450139	1108079	3237289	9512203	1353321	245242	462559
1988	4420000	170000	442000	0	30388	30658	6.8	3539021	14.9	530766	1173154	3965725	9916736	1481419	308265	653968
1989	4250000	170000	425000	0	31907	3275	7.1	3940571	15.7	618332	1245239	4668630	10321268	1618942	373703	864913
1990	4080000	170000	408000	0	33502	0	7.5	4342121	16.5	715138	1326640	5349406	10725800	1766515	439875	1090639
1991	3910000	170000	391000	0	35178	0	7.9	4743671	17.3	820335	1416513	6010220	11130332	1924798	508285	1327758
1992	3740000	170000	374000	0	36936	0	8.3	5145221	18.2	934265	1515202	6652814	11534864	2094492	579290	1573433
1993	3570000	170000	357000	0	38783	0	8.7	5546770	19.1	1057537	1623321	7278674	11939396	2276344	653024	1825202
1994	3400000	170000	340000	0	40722	0	9.1	5948320	20.0	1190801	1741523	7889067	12343928	2471145	729622	2080930
1995	3230000	170000	323000	0	42758	0	9.6	6349870	21.0	1334747	1870506	8485068	12748460	2679735	809230	2338776
1996	3060000	170000	306000	0	44896	0	10.1	6751420	22.1	1490111	2011007	9067585	13152993	2903007	891999	2597156
1997	2890000	170000	289000	0	47141	0	10.6	7152970	23.2	1657674	2163816	9637386	13557525	3141906	978090	2854718
1998	2720000	170000	272000	0	49498	0	11.1	7554520	24.3	1838269	2329767	10195113	13962057	3397437	1067671	3110310
1999	2550000	170000	255000	0	51973	0	11.6	7956070	25.6	2032778	2509751	10741308	14366589	3670667	1160916	3362959
2000	2380000	170000	238000	0	54572	0	12.2	8357620	26.8	2242143	2704715	11276422	14771121	3962727	1258012	3611850
2001	2210000	170000	221000	0	57300	0	12.8	8759170	28.2	2467362	2915663	11800829	15175653	4274815	1359153	3856305
2002	2040000	170000	204000	0	60165	0	13.5	9160720	29.6	2709498	3143664	12314844	15580185	4608206	1464542	4095770
2003	1870000	170000	187000	0	63174	0	14.2	9562270	31.1	2969679	3389853	12818724	15984717	4964249	1574395	4329793
2004	1700000	170000	170000	0	66332	0	14.9	9963820	32.6	3249105	3655437	13312685	16389249	5344375	1688938	4558021
2005	1530000	170000	153000	0	69649	0	15.6	10365370	34.2	3549049	3941698	13796907	16793782	5750104	1808406	4780176
2006	1360000	170000	136000	0	73132	0	16.4	10766920	36.0	3870864	4249996	14271538	17198314	6183044	1933048	4996055
2007	1190000	170000	119000	0	76788	0	17.2	11168470	37.7	4215989	4581777	14736706	17602846	6644903	2063126	5205515
2008	1020000	170000	102000	0	80627	0	18.1	11570020	39.6	4585949	4938576	15192517	18007378	7137490	2198914	5408466
2009	850000	170000	85000	0	84659	0	19.0	11971570	41.6	4982364	5322023	15639064	18411910	7662724	2340701	5604864
2010	680000	170000	68000	0	88892	0	19.9	12373120	43.7	5406957	5733848	16076428	18816442	8222638	2488790	5794703
2011	510000	170000	51000	0	93336	0	20.9	12774670	45.9	5861552	6175889	16504685	19220974	8819386	2643497	5978012
2012	340000	170000	34000	0	98003	0	22.0	13176220	48.2	6348090	6650094	16923903	19625506	9455252	2805159	6154847
2013	170000	170000	17000	0	102903	0	23.1	13577770	50.6	6868628	7158532	17334148	20030039	10132657	2974125	6325290

ECONOMIC ANALYSIS

NORTH FORK 2000 kW INSTALLATION
CASE A

Page	Return/Discount Rate	Inflation Rate	Fuel Escalation Rate
B-24	13%	5%	4%
B-25	13%	5%	5%
B-26	13%	5%	6%
B-27	10%	5%	5%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH FORK ONLY - 2000 kW INSTALLATION
CASE A - 0 % LOAD GROWTH

CAPITAL COST HYDRO ($)	6000000
LIFETIME (YEARS)	30
RETURN/DISCOUNT RATE	13%
INFLATION RATE	5%
FUEL ESCALATION RATE	4%

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/kW.h)	DIESEL ENERGY	DIESEL (C/kW.h)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	6000000	200000	780000	0	25000	172144	5.6	199048	12.3	34086	1039086	919545	8235788	1012178	-26908	-23812
1985	5800000	200000	754000	0	26250	172144	5.8	199048	12.8	35449	1015699	1714987	8235788	1052665	36966	5138
1986	5600000	200000	728000	0	27563	172144	6.0	199048	13.3	36867	992430	2402790	8235788	1094772	102342	76066
1987	5400000	200000	702000	0	28941	172144	6.3	199048	13.8	38342	969283	2997269	8235788	1138563	169280	179889
1988	5200000	200000	676000	0	30388	172144	6.5	199048	14.4	39876	946263	3510863	8235788	1184106	237842	308980
1989	5000000	200000	650000	0	31907	172144	6.8	199048	15.0	41471	923378	3954378	8235788	1231470	308092	456963
1990	4800000	200000	624000	0	33502	172144	7.1	199048	15.6	43129	900632	4337202	8235788	1280729	380097	618527
1991	4600000	200000	598000	0	35178	172144	7.4	199048	16.2	44855	878032	4667482	8235788	1331958	453925	789275
1992	4400000	200000	572000	0	36936	172144	7.7	199048	16.8	46649	855585	4952293	8235788	1385236	529651	965588
1993	4200000	200000	546000	0	38783	172144	8.0	199048	17.5	48515	833298	5197773	8235788	1440645	607347	1144506
1994	4000000	200000	520000	0	40722	172144	8.3	199048	18.2	50455	811178	5409245	8235788	1498271	687093	1323629
1995	3800000	200000	494000	0	42758	172144	8.6	199048	18.9	52474	789232	5591326	8235788	1558202	768970	1501035
1996	3600000	200000	468000	0	44896	172144	8.9	199048	19.7	54573	767469	5748016	8235788	1620530	853061	1675200
1997	3400000	200000	442000	0	47141	172144	9.3	199048	20.5	56755	745897	5882782	8235788	1685351	939455	1844937
1998	3200000	200000	416000	0	49498	172144	9.7	199048	21.3	59026	724524	5998627	8235788	1752765	1028241	2009344
1999	3000000	200000	390000	0	51973	172144	10.1	199048	22.1	61387	703360	6098149	8235788	1822876	1119516	2167751
2000	2800000	200000	364000	0	54572	172144	10.5	199048	23.0	63842	682414	6183600	8235788	1895791	1213377	2319688
2001	2600000	200000	338000	0	57300	172144	10.9	199048	23.9	66396	661696	6256924	8235788	1971623	1309926	2464844
2002	2400000	200000	312000	0	60165	172144	11.3	199048	24.9	69052	641217	6319804	8235788	2050488	1409270	2603042
2003	2200000	200000	286000	0	63174	172144	11.8	199048	25.9	71814	620987	6373695	8235788	2132507	1511520	2734215
2004	2000000	200000	260000	0	66332	172144	12.2	199048	26.9	74686	601019	6419852	8235788	2217807	1616789	2858382
2005	1800000	200000	234000	0	69649	172144	12.7	199048	28.0	77674	581323	6459361	8235788	2306520	1725197	2975632
2006	1600000	200000	208000	0	73132	172144	13.2	199048	29.1	80781	561912	6493157	8235788	2398780	1836868	3086110
2007	1400000	200000	182000	0	76788	172144	13.8	199048	30.3	84012	542800	6522047	8235788	2494732	1951932	3190002
2008	1200000	200000	156000	0	80627	172144	14.3	199048	31.5	87372	524000	6546729	8235788	2594521	2070521	3287527
2009	1000000	200000	130000	0	84659	172144	14.9	199048	32.8	90867	505526	6567801	8235788	2698302	2192776	3378929
2010	800000	200000	104000	0	88892	172144	15.5	199048	34.1	94502	487394	6585780	8235788	2806234	2318840	3464466
2011	600000	200000	78000	0	93336	172144	16.1	199048	35.4	98282	469618	6601110	8235788	2918483	2448865	3544407
2012	400000	200000	52000	0	98003	172144	16.8	199048	36.9	102213	452217	6614174	8235788	3035223	2583006	3619026
2013	200000	200000	26000	0	102903	172144	17.4	199048	38.3	106302	435205	6625300	8235788	3156631	2721426	3688599

CAPITAL COST HYDRO ($)	6000000
LIFETIME (YEARS)	30
RETURN/DISCOUNT RATE	13%
INFLATION RATE	5%
FUEL ESCALATION RATE	5%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH FORK ONLY - 2000 kW INSTALLATION
CASE A - 0 % LOAD GROWTH

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/kW.h)	DIESEL ENERGY	DIESEL (C/kW.h)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	6000000	200000	780000	0	25000	172144	5.6	199048	12.3	34086	1039086	919545	8235788	1012178	-26908	-23812
1985	5800000	200000	754000	0	26250	172144	5.9	199048	12.9	35790	1016040	1715253	8235788	1062787	46747	12798
1986	5600000	200000	728000	0	27563	172144	6.2	199048	13.5	37580	993142	2403551	8235788	1115927	122784	97894
1987	5400000	200000	702000	0	28941	172144	6.5	199048	14.2	39459	970399	2998715	8235788	1171723	201324	221369
1988	5200000	200000	676000	0	30388	172144	6.8	199048	14.9	41432	947819	3513153	8235788	1230309	282490	374693
1989	5000000	200000	650000	0	31907	172144	7.1	199048	15.7	43503	925410	3957645	8235788	1291825	366414	550689
1990	4800000	200000	624000	0	33502	172144	7.5	199048	16.5	45678	903181	4341551	8235788	1356416	453235	743342
1991	4600000	200000	598000	0	35178	172144	7.9	199048	17.3	47962	881140	4673001	8235788	1424237	543097	947633
1992	4400000	200000	572000	0	36936	172144	8.3	199048	18.2	50360	859297	4959048	8235788	1495448	636152	1159398
1993	4200000	200000	546000	0	38783	172144	8.7	199048	19.1	52878	837662	5205813	8235788	1570221	732559	1375201
1994	4000000	200000	520000	0	40722	172144	9.1	199048	20.0	55522	816245	5418606	8235788	1648732	832487	1592229
1995	3800000	200000	494000	0	42758	172144	9.6	199048	21.0	58298	795057	5602030	8235788	1731168	936112	1808195
1996	3600000	200000	468000	0	44896	172144	10.0	199048	22.1	61213	774110	5760076	8235788	1817727	1043617	2021265
1997	3400000	200000	442000	0	47141	172144	10.5	199048	23.2	64274	753415	5896200	8235788	1908613	1155198	2229982
1998	3200000	200000	416000	0	49498	172144	11.1	199048	24.3	67488	732986	6013398	8235788	2004044	1271058	2433213
1999	3000000	200000	390000	0	51973	172144	11.6	199048	25.6	70862	712835	6114262	8235788	2104246	1391411	2630092
2000	2800000	200000	364000	0	54572	172144	12.2	199048	26.8	74405	692977	6201035	8235788	2209458	1516481	2819983
2001	2600000	200000	338000	0	57300	172144	12.8	199048	28.2	78125	673426	6275659	8235788	2319931	1646505	3002436
2002	2400000	200000	312000	0	60165	172144	13.5	199048	29.6	82032	654197	6339812	8235788	2435928	1781731	3177159
2003	2200000	200000	286000	0	63174	172144	14.1	199048	31.1	86133	635307	6394945	8235788	2557724	1922417	3343991
2004	2000000	200000	260000	0	66332	172144	14.8	199048	32.6	90440	616772	6442312	8235788	2685610	2068838	3502875
2005	1800000	200000	234000	0	69649	172144	15.6	199048	34.2	94962	598611	6482996	8235788	2819891	2221280	3653840
2006	1600000	200000	208000	0	73132	172144	16.4	199048	36.0	99710	580842	6517930	8235788	2960886	2380044	3796987
2007	1400000	200000	182000	0	76788	172144	17.2	199048	37.7	104695	563484	6547922	8235788	3108930	2545446	3932469
2008	1200000	200000	156000	0	80627	172144	18.0	199048	39.6	109930	546558	6573666	8235788	3264376	2717819	4060483
2009	1000000	200000	130000	0	84659	172144	18.9	199048	41.6	115427	530086	6595761	8235788	3427595	2897509	4181260
2010	800000	200000	104000	0	88892	172144	19.9	199048	43.7	121198	514090	6614725	8235788	3598975	3084885	4295055
2011	600000	200000	78000	0	93336	172144	20.9	199048	45.9	127258	498594	6631001	8235788	3778924	3280329	4402138
2012	400000	200000	52000	0	98003	172144	21.9	199048	48.2	133621	483624	6644972	8235788	3967870	3484246	4502793
2013	200000	200000	26000	0	102903	172144	23.0	199048	50.6	140302	469205	6656968	8235788	4166263	3697058	4597308

CAPITAL COST HYDRO ($) 6000000
LIFETIME (YEARS) 30
RETURN/DISCOUNT RATE 13%
INFLATION RATE 5%
FUEL ESCALATION RATE 6%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH FORK ONLY - 2000 kW INSTALLATION
CASE A - 0 % LOAD GROWTH

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/kW.h)	DIESEL ENERGY	DIESEL (C/kW.h)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	6000000	200000	780000	0	25000	172144	5.6	199048	12.3	34086	1039086	919545	8235788	1012178	-26908	-23812
1985	5800000	200000	754000	0	26250	172144	5.9	199048	13.0	36131	1016381	1715520	8235788	1072909	56528	20458
1986	5600000	200000	728000	0	27563	172144	6.3	199048	13.8	38299	993861	2404316	8235788	1137284	143422	119857
1987	5400000	200000	702000	0	28941	172144	6.7	199048	14.6	40597	971537	3000178	8235788	1205521	233983	263363
1988	5200000	200000	676000	0	30388	172144	7.1	199048	15.5	43033	949420	3515486	8235788	1277852	328432	441622
1989	5000000	200000	650000	0	31907	172144	7.5	199048	16.4	45615	927522	3960991	8235788	1354523	427001	646719
1990	4800000	200000	624000	0	33502	172144	7.9	199048	17.4	48351	905854	4346034	8235788	1435794	529941	871976
1991	4600000	200000	598000	0	35178	172144	8.4	199048	18.5	51253	884430	4678721	8235788	1521942	637512	1111782
1992	4400000	200000	572000	0	36936	172144	8.9	199048	19.6	54328	863264	4966089	8235788	1613259	749994	1361444
1993	4200000	200000	546000	0	38783	172144	9.4	199048	20.8	57587	842371	5214241	8235788	1710054	867683	1617054
1994	4000000	200000	520000	0	40722	172144	10.0	199048	22.0	61043	821765	5428473	8235788	1812657	990892	1875377
1995	3800000	200000	494000	0	42758	172144	10.6	199048	23.3	64705	801464	5613376	8235788	1921417	1119953	2133757
1996	3600000	200000	468000	0	44896	172144	11.2	199048	24.7	68587	781484	5772927	8235788	2036702	1255218	2390028
1997	3400000	200000	442000	0	47141	172144	11.9	199048	26.2	72703	761844	5910574	8235788	2158904	1397060	2642444
1998	3200000	200000	416000	0	49498	172144	12.6	199048	27.8	77065	742563	6029303	8235788	2288438	1545875	2889615
1999	3000000	200000	390000	0	51973	172144	13.4	199048	29.5	81689	723662	6131699	8235788	2425744	1702082	3130453
2000	2800000	200000	364000	0	54572	172144	14.2	199048	31.2	86590	705162	6219998	8235788	2571289	1866127	3364125
2001	2600000	200000	338000	0	57300	172144	15.1	199048	33.1	91785	687086	6296135	8235788	2725566	2038480	3590014
2002	2400000	200000	312000	0	60165	172144	16.0	199048	35.1	97293	669458	6361785	8235788	2889100	2219642	3807681
2003	2200000	200000	286000	0	63174	172144	16.9	199048	37.2	103130	652304	6418393	8235788	3062446	2410142	4016839
2004	2000000	200000	260000	0	66332	172144	17.9	199048	39.4	109318	635650	6467210	8235788	3246193	2610543	4217325
2005	1800000	200000	234000	0	69649	172144	19.0	199048	41.8	115877	619526	6509316	8235788	3440965	2821439	4409079
2006	1600000	200000	208000	0	73132	172144	20.1	199048	44.3	122830	603961	6545640	8235788	3647423	3043461	4592126
2007	1400000	200000	182000	0	76788	172144	21.4	199048	46.9	130199	588988	6576989	8235788	3866268	3277280	4766560
2008	1200000	200000	156000	0	80627	172144	22.6	199048	49.8	138011	574639	6604056	8235788	4098244	3523605	4932529
2009	1000000	200000	130000	0	84659	172144	24.0	199048	52.7	146292	560951	6627438	8235788	4344139	3783188	5090224
2010	800000	200000	104000	0	88892	172144	25.4	199048	55.9	155070	547961	6647651	8235788	4604787	4056826	5239871
2011	600000	200000	78000	0	93336	172144	27.0	199048	59.3	164374	535710	6665139	8235788	4881074	4345364	5381721
2012	400000	200000	52000	0	98003	172144	28.6	199048	62.8	174236	524239	6680284	8235788	5173939	4649699	5516044
2013	200000	200000	26000	0	102903	172144	30.3	199048	66.6	184690	513594	6693414	8235788	5484375	4970781	5643122

CAPITAL COST HYDRO ($) 6000000
LIFETIME (YEARS) 30
RETURN/DISCOUNT RATE 10%
INFLATION RATE 5%
FUEL ESCALATION RATE 5%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH FORK ONLY - 2000 kW INSTALLATION
CASE A - 0 % LOAD GROWTH

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/kW.h)	DIESEL ENERGY	DIESEL (C/kW.h)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	6000000	200000	600000	0	25000	172144	5.6	199048	12.3	34086	859086	780987	8235788	1012178	153092	139175
1985	5800000	200000	580000	0	26250	172144	5.9	199048	12.9	35790	842040	1476888	8235788	1062787	220747	321611
1986	5600000	200000	560000	0	27563	172144	6.2	199048	13.5	37580	825142	2096830	8235788	1115927	290784	540081
1987	5400000	200000	540000	0	28941	172144	6.5	199048	14.2	39459	808399	2648977	8235788	1171723	363324	788236
1988	5200000	200000	520000	0	30388	172144	6.8	199048	14.9	41432	791819	3140635	8235788	1230309	438490	1060504
1989	5000000	200000	500000	0	31907	172144	7.1	199048	15.7	43503	775410	3578333	8235788	1291825	516414	1352006
1990	4800000	200000	480000	0	33502	172144	7.5	199048	16.5	45678	759181	3967913	8235788	1356416	597235	1658483
1991	4600000	200000	460000	0	35178	172144	7.9	199048	17.3	47962	743140	4314593	8235788	1424237	681097	1976219
1992	4400000	200000	440000	0	36936	172144	8.3	199048	18.2	50360	727297	4623038	8235788	1495448	768152	2301991
1993	4200000	200000	420000	0	38783	172144	8.7	199048	19.1	52878	711662	4897414	8235788	1570221	858559	2633002
1994	4000000	200000	400000	0	40722	172144	9.1	199048	20.0	55522	696245	5141444	8235788	1648732	952487	2966843
1995	3800000	200000	380000	0	42758	172144	9.6	199048	21.0	58298	681057	5358450	8235788	1731168	1050112	3301441
1996	3600000	200000	360000	0	44896	172144	10.0	199048	22.1	61213	666110	5551398	8235788	1817727	1151617	3635024
1997	3400000	200000	340000	0	47141	172144	10.5	199048	23.2	64274	651415	5722936	8235788	1908613	1257198	3966083
1998	3200000	200000	320000	0	49498	172144	11.1	199048	24.3	67488	636986	5875425	8235788	2004044	1367058	4293346
1999	3000000	200000	300000	0	51973	172144	11.6	199048	25.6	70862	622835	6010972	8235788	2104246	1481411	4615744
2000	2800000	200000	280000	0	54572	172144	12.2	199048	26.8	74405	608977	6131455	8235788	2209458	1600481	4932391
2001	2600000	200000	260000	0	57300	172144	12.8	199048	28.2	78125	595426	6238548	8235788	2319931	1724505	5242558
2002	2400000	200000	240000	0	60165	172144	13.5	199048	29.6	82032	582197	6333742	8235788	2435928	1853731	5545658
2003	2200000	200000	220000	0	63174	172144	14.1	199048	31.1	86133	569307	6418366	8235788	2557724	1988417	5841224
2004	2000000	200000	200000	0	66332	172144	14.8	199048	32.6	90440	556772	6493602	8235788	2685610	2128838	6128895
2005	1800000	200000	180000	0	69649	172144	15.6	199048	34.2	94962	544611	6560506	8235788	2819891	2275280	6408404
2006	1600000	200000	160000	0	73132	172144	16.4	199048	36.0	99710	532842	6620012	8235788	2960886	2428044	6679563
2007	1400000	200000	140000	0	76788	172144	17.2	199048	37.7	104695	521484	6672956	8235788	3108930	2587446	6942255
2008	1200000	200000	120000	0	80627	172144	18.0	199048	39.6	109930	510558	6720079	8235788	3264376	2753819	7196422
2009	1000000	200000	100000	0	84659	172144	18.9	199048	41.6	115427	500086	6762039	8235788	3427595	2927509	7442056
2010	800000	200000	80000	0	88892	172144	19.9	199048	43.7	121198	490090	6799422	8235788	3598975	3108885	7679194
2011	600000	200000	60000	0	93336	172144	20.9	199048	45.9	127258	480594	6832748	8235788	3778924	3298329	7907911
2012	400000	200000	40000	0	98003	172144	21.9	199048	48.2	133621	471624	6862479	8235788	3967870	3496246	8128313
2013	200000	200000	20000	0	102903	172144	23.0	199048	50.6	140302	463205	6889024	8235788	4166263	3703058	8340530

ECONOMIC ANALYSIS

NORTH FORK 2000 kW INSTALLATION
CASE B

Page	Return/Discount Rate	Inflation Rate	Fuel Escalation Rate
B-29	13%	5%	4%
B-30	13%	5%	5%
B-31	13%	5%	6%
B-32	10%	5%	5%

CAPITAL COST HYDRO ($) 6000000
LIFETIME (YEARS) 30
RETURN/DISCOUNT RATE 13%
INFLATION RATE 5%
FUEL ESCALATION RATE 4%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH FORK ONLY - 2000 kW INSTALLATION
CASE B - 1.6% LOAD GROWTH

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/kW.h)	DIESEL ENERGY	DIESEL (C/kW.h)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	6000000	200000	780000	0	25000	172144	5.6	199048	12.3	34086	1039086	919545	8235788	1012178	-26908	-23812
1985	5800000	200000	754000	0	26250	158206	5.8	228811	12.8	38443	1018693	1717331	8369557	1069763	51070	16183
1986	5600000	200000	728000	0	27563	126048	6.0	264209	13.3	42742	998305	2409206	8503470	1130355	132050	107701
1987	5400000	200000	702000	0	28941	104572	6.3	299029	13.8	47915	978856	3009557	8639525	1194378	215522	239885
1988	5200000	200000	676000	0	30388	81231	6.5	346377	14.4	55113	961500	3531421	8777758	1262028	300527	402999
1989	5000000	200000	650000	0	31907	74743	6.8	384539	15.0	62582	944489	3985076	8918202	1333509	389020	589852
1990	4800000	200000	624000	0	33502	66306	7.1	427202	15.6	71123	928625	4379798	9060893	1409039	480413	794057
1991	4600000	200000	598000	0	35178	59346	7.4	472419	16.2	80769	913946	4723588	9205867	1488847	574900	1010311
1992	4400000	200000	572000	0	36936	52253	7.7	521961	16.8	91790	900726	5023426	9353161	1573175	672449	1234159
1993	4200000	200000	546000	0	38783	42445	8.0	571311	17.5	103314	888097	5285049	9502812	1662280	774183	1462224
1994	4000000	200000	520000	0	40722	34849	8.3	619446	18.2	115574	876297	5513498	9654857	1756431	880134	1691673
1995	3800000	200000	494000	0	42758	23963	8.6	672522	18.9	129303	866061	5713303	9809334	1855915	989854	1920039
1996	3600000	200000	468000	0	44896	15839	8.9	724020	19.7	143881	856777	5888227	9966284	1961034	1104257	2145489
1997	3400000	200000	442000	0	47141	7562	9.3	777586	20.5	159827	848968	6041616	10125744	2072107	1223139	2366481
1998	3200000	200000	416000	0	49498	0	9.7	839312	21.3	178625	844123	6176583	10287756	2189471	1345348	2581590
1999	3000000	200000	390000	0	51973	0	10.1	898967	22.1	198974	840947	6295574	10452360	2313483	1472536	2789948
2000	2800000	200000	364000	0	54572	0	10.5	967223	23.0	222644	841216	6400909	10619598	2444519	1603303	2990710
2001	2600000	200000	338000	0	57300	0	10.9	1030254	23.9	246640	841940	6494206	10789512	2582976	1741036	3183639
2002	2400000	200000	312000	0	60165	0	11.3	1105725	24.9	275295	847461	6577312	10962144	2729276	1881815	3368177
2003	2200000	200000	286000	0	63174	0	11.8	1173805	25.9	303935	853109	6651347	11137538	2883862	2030753	3544410
2004	2000000	200000	260000	0	66332	0	12.2	1240642	26.9	334091	860424	6717426	11315739	3047204	2186781	3712352
2005	1800000	200000	234000	0	69649	0	12.7	1311761	28.0	367373	871022	6776623	11496790	3219798	2348776	3871982
2006	1600000	200000	208000	0	73132	0	13.2	1413727	29.1	411766	892898	6830326	11680739	3402167	2509270	4022901
2007	1400000	200000	182000	0	76788	0	13.8	1519442	30.3	460259	919048	6879243	11867631	3594866	2675819	4165322
2008	1200000	200000	156000	0	80627	0	14.3	1625816	31.5	512181	948808	6923933	12057513	3798479	2849671	4299547
2009	1000000	200000	130000	0	84659	0	14.9	1751355	32.8	573799	988458	6965136	12250433	4013625	3025168	4425646
2010	800000	200000	104000	0	88892	0	15.5	1882142	34.1	641315	1034206	7003285	12446440	4240957	3206750	4543936
2011	600000	200000	78000	0	93336	0	16.1	2036695	35.4	721736	1093072	7038967	12645583	4481165	3388093	4654536
2012	400000	200000	52000	0	98003	0	16.8	2208728	36.9	814006	1164009	7072594	12847913	4734978	3570969	4757696
2013	200000	200000	26000	0	102903	0	17.4	2383191	38.3	913435	1242338	7104354	13053479	5003167	3760829	4853842

27-Mar-85

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH FORK ONLY - 2000 kW INSTALLATION
CASE B - 1.6% LOAD GROWTH

CAPITAL COST HYDRO ($)	6000000
LIFETIME (YEARS)	30
RETURN/DISCOUNT RATE	13%
INFLATION RATE	5%
FUEL ESCALATION RATE	5%

YEAR	RATE' BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/kW.h)	DIESEL ENERGY	DIESEL (C/kW.h)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	6000000	200000	780000	0	25000	172144	5.6	199048	12.3	34086	1039086	919545	8235788	1012178	-26908	-23812
1985	5800000	200000	754000	0	26250	158206	5.9	228811	12.9	38813	1019063	1717621	8369557	1080049	60987	23949
1986	5600000	200000	728000	0	27563	126048	6.2	264209	13.5	43568	999130	2410068	8503470	1152197	153066	130032
1987	5400000	200000	702000	0	28941	104572	6.5	299029	14.2	49310	980251	3011275	8639525	1229163	248912	282695
1988	5200000	200000	676000	0	30388	81231	6.8	346377	14.9	57263	963651	3534306	8777758	1311272	347621	471369
1989	5000000	200000	650000	0	31907	74743	7.1	384539	15.7	65649	947556	3989435	8918202	1398865	451308	688141
1990	4800000	200000	624000	0	33502	66306	7.5	427202	16.5	75326	932829	4385943	9060893	1492309	559480	925954
1991	4600000	200000	598000	0	35178	59346	7.9	472419	17.3	86365	919542	4731838	9205867	1591995	672453	1178904
1992	4400000	200000	572000	0	36936	52253	8.3	521961	18.2	99093	908029	5034107	9353161	1698340	790311	1441986
1993	4200000	200000	546000	0	38783	42445	8.7	571311	19.1	112606	897389	5298468	9502812	1811789	914400	1711358
1994	4000000	200000	520000	0	40722	34849	9.1	619446	20.0	127181	887903	5529942	9654857	1932817	1044914	1983765
1995	3800000	200000	494000	0	42758	23963	9.6	672522	21.0	143656	880414	5733059	9809334	2061929	1181515	2256347
1996	3600000	200000	468000	0	44896	15839	10.0	724020	22.1	161389	874285	5911557	9966284	2199666	1325380	2526943
1997	3400000	200000	442000	0	47141	7562	10.5	777586	23.2	181000	870141	6068771	10125744	2346604	1476463	2793705
1998	3200000	200000	416000	0	49498	0	11.1	839312	24.3	204233	869731	6207833	10287756	2503357	1633626	3054906
1999	3000000	200000	390000	0	51973	0	11.6	898967	25.6	229686	871659	6331169	10452360	2670581	1798921	3309447
2000	2800000	200000	364000	0	54572	0	12.2	967223	26.8	259482	878054	6441117	10619598	2848976	1970922	3556242
2001	2600000	200000	338000	0	57300	0	12.8	1030254	28.2	290211	885512	6539243	10789512	3039287	2153776	3794907
2002	2400000	200000	312000	0	60165	0	13.5	1105725	29.6	327044	899210	6627423	10962144	3242312	2343102	4024681
2003	2200000	200000	286000	0	63174	0	14.1	1173805	31.1	364539	913713	6706717	11137538	3458898	2545185	4245558
2004	2000000	200000	260000	0	66332	0	14.8	1240642	32.6	404561	930894	6778208	11315739	3689952	2759059	4457449
2005	1800000	200000	234000	0	69649	0	15.6	1311761	34.2	449140	952789	6842963	11496790	3936441	2983652	4660228
2006	1600000	200000	208000	0	73132	0	16.4	1413727	36.0	508255	989387	6902469	11680739	4199396	3210009	4853292
2007	1400000	200000	182000	0	76788	0	17.2	1519442	37.7	573574	1032363	6957417	11867631	4479915	3447553	5036789
2008	1200000	200000	156000	0	80627	0	18.0	1625816	39.6	644416	1081044	7008336	12057513	4779174	3698130	5210978
2009	1000000	200000	130000	0	84659	0	18.9	1751355	41.6	728884	1143543	7056003	12250433	5098422	3954879	5375830
2010	800000	200000	104000	0	88892	0	19.9	1882142	43.7	822481	1215373	7100835	12446440	5438997	4223624	5531630
2011	600000	200000	78000	0	93336	0	20.9	2036695	45.9	934521	1305857	7143463	12645583	5802322	4496465	5678412
2012	400000	200000	52000	0	98003	0	21.9	2208728	48.2	1064130	1414133	7184316	12847913	6189917	4775784	5816378
2013	200000	200000	26000	0	102903	0	23.0	2383191	50.6	1205592	1534495	7223545	13053479	6603404	5068908	5945965

CAPITAL COST HYDRO ($)	6000000
LIFETIME (YEARS)	30
RETURN/DISCOUNT RATE	13%
INFLATION RATE	5%
FUEL ESCALATION RATE	6%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH FORK ONLY - 2000 kW INSTALLATION
CASE B - 1.6% LOAD GROWTH

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/kW.h)	DIESEL ENERGY	DIESEL (C/kW.h)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	6000000	200000	780000	0	25000	172144	5.6	199048	12.3	34086	1039086	919545	8235788	1012178	-26908	-23812
1985	5800000	200000	754000	0	26250	158206	5.9	228811	13.0	39183	1019433	1717910	8369557	1090336	70903	31716
1986	5600000	200000	728000	0	27563	126048	6.3	264209	13.8	44402	999964	2410936	8503470	1174248	174284	152503
1987	5400000	200000	702000	0	28941	104572	6.7	299029	14.6	50733	981673	3013014	8639525	1264618	282945	326038
1988	5200000	200000	676000	0	30388	81231	7.1	346377	15.5	59476	965864	3537246	8777758	1361943	396079	541014
1989	5000000	200000	650000	0	31907	74743	7.5	384539	16.4	68836	950743	3993906	8918202	1466758	516015	788866
1990	4800000	200000	624000	0	33502	66306	7.9	427202	17.4	79734	937237	4392288	9060893	1579640	642403	1061926
1991	4600000	200000	598000	0	35178	59346	8.4	472419	18.5	92289	925467	4740412	9205867	1701209	775742	1353729
1992	4400000	200000	572000	0	36936	52253	8.9	521961	19.6	106899	915836	5045279	9353161	1832134	916298	1658751
1993	4200000	200000	546000	0	38783	42445	9.4	571311	20.8	122634	907417	5312594	9502812	1973135	1065718	1972609
1994	4000000	200000	520000	0	40722	34849	10.0	619446	22.0	139826	900548	5547365	9654857	2124987	1224439	2291907
1995	3800000	200000	494000	0	42758	23963	10.6	672522	23.3	159443	896201	5754124	9809334	2288526	1392325	2613125
1996	3600000	200000	468000	0	44896	15839	11.2	724020	24.7	180831	893727	5936591	9966284	2464651	1570924	2933852
1997	3400000	200000	442000	0	47141	7562	11.9	777586	26.2	204735	893877	6098094	10125744	2654331	1760454	3251925
1998	3200000	200000	416000	0	49498	0	12.6	839312	27.8	233216	898714	6241790	10287756	2858608	1959895	3565294
1999	3000000	200000	390000	0	51973	0	13.4	898967	29.5	264779	906752	6370092	10452360	3078607	2171855	3872603
2000	2800000	200000	364000	0	54572	0	14.2	967223	31.2	301976	920548	6485361	10619598	3315536	2394989	4172499
2001	2600000	200000	338000	0	57300	0	15.1	1030254	33.1	340954	936254	6589109	10789512	3570700	2634446	4464428
2002	2400000	200000	312000	0	60165	0	16.0	1105725	35.1	387886	960052	6683256	10962144	3845501	2885449	4747386
2003	2200000	200000	286000	0	63174	0	16.9	1173805	37.2	436475	985649	6768793	11137538	4141451	3155802	5021254
2004	2000000	200000	260000	0	66332	0	17.9	1240642	39.4	489008	1015340	6846769	11315739	4460177	3444837	5285812
2005	1800000	200000	234000	0	69649	0	19.0	1311761	41.8	548062	1051711	6918247	11496790	4803432	3751721	5540792
2006	1600000	200000	208000	0	73132	0	20.1	1413727	44.3	626104	1107235	6984841	11680739	5173104	4065869	5785331
2007	1400000	200000	182000	0	76788	0	21.4	1519442	46.9	713298	1172086	7047225	11867631	5571227	4399141	6019476
2008	1200000	200000	156000	0	80627	0	22.6	1625816	49.8	809029	1245656	7105898	12057513	5999988	4754332	6243415
2009	1000000	200000	130000	0	84659	0	24.0	1751355	52.7	923789	1338448	7161689	12250433	6461747	5123300	6456970
2010	800000	200000	104000	0	88892	0	25.4	1882142	55.9	1052342	1445234	7215000	12446440	6959043	5513810	6660362
2011	600000	200000	78000	0	93336	0	27.0	2036695	59.3	1207081	1578417	7266526	12645583	7494611	5916194	6853490
2012	400000	200000	52000	0	98003	0	28.6	2208728	62.8	1387581	1737584	7316723	12847913	8071397	6333812	7036465
2013	200000	200000	26000	0	102903	0	30.3	2383191	66.6	1587014	1915918	7365703	13053479	8692571	6776654	7209710

CAPITAL COST HYDRO ($) 6000000
LIFETIME (YEARS) 30
RETURN/DISCOUNT RATE 10%
INFLATION RATE 5%
FUEL ESCALATION RATE 5%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH FORK ONLY - 2000 kW INSTALLATION
CASE B - 1.6% LOAD GROWTH

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/kW.h)	DIESEL ENERGY	DIESEL (C/kW.h)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	6000000	200000	600000	0	25000	172144	5.6	199048	12.3	34086	859086	780987	8235788	1012178	153092	139175
1985	5800000	200000	580000	0	26250	158206	5.9	228811	12.9	38813	845063	1479386	8369557	1080049	234987	333379
1986	5600000	200000	560000	0	27563	126048	6.2	264209	13.5	43568	831130	2103827	8503470	1152197	321066	574601
1987	5400000	200000	540000	0	28941	104572	6.5	299029	14.2	49310	818251	2662703	8639525	1229163	410912	855259
1988	5200000	200000	520000	0	30388	81231	6.8	346377	14.9	57263	807651	3164191	8777758	1311272	503621	1167968
1989	5000000	200000	500000	0	31907	74743	7.1	384539	15.7	65649	797556	3614391	8918202	1398865	601308	1507391
1990	4800000	200000	480000	0	33502	66306	7.5	427202	16.5	75326	788829	4019185	9060893	1492309	703480	1868388
1991	4600000	200000	460000	0	35178	59346	7.9	472419	17.3	86365	781542	4383780	9205867	1591995	810453	2246470
1992	4400000	200000	440000	0	36936	52253	8.3	521961	18.2	99093	776029	4712892	9353161	1698340	922311	2637620
1993	4200000	200000	420000	0	38783	42445	8.7	571311	19.1	112606	771389	5010296	9502812	1811789	1040400	3038739
1994	4000000	200000	400000	0	40722	34849	9.1	619446	20.0	127181	767903	5279441	9654857	1932817	1164914	3447034
1995	3800000	200000	380000	0	42758	23963	9.6	672522	21.0	143656	766414	5523644	9809334	2061929	1295515	3859825
1996	3600000	200000	360000	0	44896	15839	10.0	724020	22.1	161389	766285	5745610	9966284	2199666	1433380	4275024
1997	3400000	200000	340000	0	47141	7562	10.5	777586	23.2	181000	768141	5947885	10125744	2346604	1578463	4690683
1998	3200000	200000	320000	0	49498	0	11.1	839312	24.3	204233	773731	6133110	10287756	2503357	1729626	5104742
1999	3000000	200000	300000	0	51973	0	11.6	898967	25.6	229686	781659	6303222	10452360	2670581	1888921	5515826
2000	2800000	200000	280000	0	54572	0	12.2	967223	26.8	259482	794054	6460322	10619598	2848976	2054922	5922381
2001	2600000	200000	260000	0	57300	0	12.8	1030254	28.2	290211	807512	6605560	10789512	3039287	2231776	6323786
2002	2400000	200000	240000	0	60165	0	13.5	1105725	29.6	327044	827210	6740815	10962144	3242312	2415102	6718674
2003	2200000	200000	220000	0	63174	0	14.1	1173805	31.1	364539	847713	6866822	11137538	3458898	2611185	7106810
2004	2000000	200000	200000	0	66332	0	14.8	1240642	32.6	404561	870894	6984507	11315739	3689952	2819059	7487751
2005	1800000	200000	180000	0	69649	0	15.6	1311761	34.2	449140	898789	7094919	11496790	3936441	3037652	7860915
2006	1600000	200000	160000	0	73132	0	16.4	1413727	36.0	508255	941387	7200052	11680739	4199396	3258009	8224763
2007	1400000	200000	140000	0	76788	0	17.2	1519442	37.7	573574	990363	7300599	11867631	4479915	3489553	8579042
2008	1200000	200000	120000	0	80627	0	18.0	1625816	39.6	644416	1045044	7397052	12057513	4779174	3734130	8923687
2009	1000000	200000	100000	0	84659	0	18.9	1751355	41.6	728884	1113543	7490484	12250433	5098422	3984879	9258040
2010	800000	200000	80000	0	88892	0	19.9	1882142	43.7	822481	1191373	7581360	12446440	5438997	4247624	9582039
2011	600000	200000	60000	0	93336	0	20.9	2036695	45.9	934521	1287857	7670664	12645583	5802322	4514465	9895087
2012	400000	200000	40000	0	98003	0	21.9	2208728	48.2	1064130	1402133	7759054	12847913	6189917	4787784	10196906
2013	200000	200000	20000	0	102903	0	23.0	2383191	50.6	1205592	1528495	7846649	13053479	6603404	5074908	10487742

ECONOMIC ANALYSIS

NORTH FORK 2000 kW INSTALLATION
CASE C

Page	Return/Discount Rate	Inflation Rate	Fuel Escalation Rate
B-34	13%	5%	4%
B-35	13%	5%	5%
B-36	13%	5%	6%
B-37	10%	5%	5%

CAPITAL COST HYDRO ($) 6000000
LIFETIME (YEARS) 30
RETURN/DISCOUNT RATE 13%
INFLATION RATE 5%
FUEL ESCALATION RATE 4%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH FORK ONLY - 2000 KW INSTALLATION
CASE C - 70 KW ADDED TO YEARLY PEAK

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/kW.h)	DIESEL ENERGY	DIESEL (C/kW.h)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	6000000	200000	780000	0	25000	172144	5.6	199048	12.3	34086	1039086	919545	8235788	1012178	-26908	-23812
1985	5800000	200000	754000	0	26250	136491	5.8	307582	12.8	47249	1027499	1724227	8703139	1112400	84901	42678
1986	5600000	200000	728000	0	27563	79857	6.0	424685	13.3	61281	1016844	2428951	9107671	1210670	193827	177010
1987	5400000	200000	702000	0	28941	32078	6.3	551923	13.8	78318	1009259	3047948	9512203	1315022	305763	364540
1988	5200000	200000	676000	0	30388	4597	6.5	682940	14.4	98491	1004878	3593356	9916736	1425785	420906	592992
1989	5000000	200000	650000	0	31907	0	6.8	824142	15.0	123231	1005138	4076142	10321268	1543304	538166	851483
1990	4800000	200000	624000	0	33502	0	7.1	976796	15.6	151899	1009402	4505199	10725800	1667945	658543	1131403
1991	4600000	200000	598000	0	35178	0	7.4	1139423	16.2	184277	1017454	4887925	11130332	1800086	782632	1425798
1992	4400000	200000	572000	0	36936	0	7.7	1294060	16.8	217657	1026594	5229662	11534864	1940131	913537	1729901
1993	4200000	200000	546000	0	38783	0	8.0	1513617	17.5	264770	1049553	5538848	11939396	2088499	1038946	2035963
1994	4000000	200000	520000	0	40722	0	8.3	1753909	18.2	319075	1079797	5820349	12343928	2245632	1165835	2339893
1995	3800000	200000	494000	0	42758	0	8.6	2047350	18.9	387356	1124115	6079689	12748460	2411995	1287880	2637015
1996	3600000	200000	468000	0	44896	0	8.9	2388706	19.7	470018	1182915	6321198	13152993	2588073	1405159	2923898
1997	3400000	200000	442000	0	47141	0	9.3	2734511	20.5	559584	1248725	6546813	13557525	2774378	1525654	3199548
1998	3200000	200000	416000	0	49498	0	9.7	3119391	21.3	663878	1329377	6759368	13962057	2971447	1642071	3462100
1999	3000000	200000	390000	0	51973	0	10.1	3513115	22.1	777579	1419552	6960229	14366589	3179843	1760291	3711174
2000	2800000	200000	364000	0	54572	0	10.5	3906839	23.0	899313	1517885	7150296	14771121	3400155	1882271	3946868
2001	2600000	200000	338000	0	57300	0	10.9	4300563	23.9	1029542	1624842	7330348	15175653	3633005	2008163	4169398
2002	2400000	200000	312000	0	60165	0	11.3	4694287	24.9	1168750	1740915	7501069	15580185	3879043	2138128	4379071
2003	2200000	200000	286000	0	63174	0	11.8	5088010	25.9	1317448	1866621	7663059	15984717	4138951	2272330	4576269
2004	2000000	200000	260000	0	66332	0	12.2	5481734	26.9	1476171	2002503	7816848	16389249	4413445	2410942	4761426
2005	1800000	200000	234000	0	69649	0	12.7	5875458	28.0	1645484	2149133	7962911	16793782	4703276	2554143	4935014
2006	1600000	200000	208000	0	73132	0	13.2	6269182	29.1	1825981	2307112	8101671	17198314	5009233	2702120	5097531
2007	1400000	200000	182000	0	76788	0	13.8	6662906	30.3	2018284	2477073	8233513	17602846	5332140	2855068	5249493
2008	1200000	200000	156000	0	80627	0	14.3	7056630	31.5	2223051	2659678	8358789	18007378	5672866	3013188	5391420
2009	1000000	200000	130000	0	84659	0	14.9	7450354	32.8	2440969	2855628	8477821	18411910	6032318	3176690	5523834
2010	800000	200000	104000	0	88892	0	15.5	7844078	34.1	2672764	3065656	8590906	18816442	6411449	3345794	5647253
2011	600000	200000	78000	0	93336	0	16.1	8237802	35.4	2919197	3290533	8698322	19220974	6811260	3520727	5762184
2012	400000	200000	52000	0	98003	0	16.8	8631526	36.9	3181068	3531071	8800330	19625506	7232797	3701726	5869121
2013	200000	200000	26000	0	102903	0	17.4	9025249	38.3	3459218	3788121	8897173	20030039	7677159	3889037	5968544

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH FORK ONLY - 2000 KW INSTALLATION
CASE C - 70 KW ADDED TO YEARLY PEAK

CAPITAL COST HYDRO ($)	6000000
LIFETIME (YEARS)	30
RETURN/DISCOUNT RATE	13%
INFLATION RATE	5%
FUEL ESCALATION RATE	5%

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/kW.h)	DIESEL ENERGY	DIESEL (C/kW.h)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	6000000	200000	780000	0	25000	172144	5.6	199048	12.3	34086	1039086	919545	8235788	1012178	-26908	-23812
1985	5800000	200000	754000	0	26250	136491	5.9	307582	12.9	47703	1027953	1724583	8703139	1123097	95143	50699
1986	5600000	200000	728000	0	27563	79857	6.2	424685	13.5	62465	1018028	2430128	9107671	1234064	216037	200423
1987	5400000	200000	702000	0	28941	32078	6.5	551923	14.2	80599	1011540	3050524	9512203	1353321	341782	410045
1988	5200000	200000	676000	0	30388	4597	6.8	682940	14.9	102334	1008721	3598017	9916736	1481419	472697	666606
1989	5000000	200000	650000	0	31907	0	7.1	824142	15.7	129271	1011178	4083705	10321268	1618942	607765	958526
1990	4800000	200000	624000	0	33502	0	7.5	976796	16.5	160876	1018379	4516577	10725800	1766515	748137	1276530
1991	4600000	200000	598000	0	35178	0	7.9	1139423	17.3	197043	1030221	4904105	11130332	1924798	894577	1613034
1992	4400000	200000	572000	0	36936	0	8.3	1294060	18.2	234975	1043911	5251607	11534864	2094492	1050581	1962756
1993	4200000	200000	546000	0	38783	0	8.7	1513617	19.1	288584	1073367	5567809	11939396	2276344	1202977	2317139
1994	4000000	200000	520000	0	40722	0	9.1	1753909	20.0	351117	1111839	5857663	12343928	2471145	1359306	2671507
1995	3800000	200000	494000	0	42758	0	9.6	2047350	21.0	430354	1167113	6126922	12748460	2679735	1512622	3020478
1996	3600000	200000	468000	0	44896	0	10.0	2388706	22.1	527213	1240109	6380109	13152993	2903007	1662897	3359983
1997	3400000	200000	442000	0	47141	0	10.5	2734511	23.2	633713	1322854	6619117	13557525	3141906	1819052	3688643
1998	3200000	200000	416000	0	49498	0	11.1	3119391	24.3	759053	1424551	6846890	13962057	3397437	1972887	4004089
1999	3000000	200000	390000	0	51973	0	11.6	3513115	25.6	897602	1539575	7064734	14366589	3670667	2131092	4305631
2000	2800000	200000	364000	0	54572	0	12.2	3906839	26.8	1048108	1666680	7273432	14771121	3962727	2296047	4593137
2001	2600000	200000	338000	0	57300	0	12.8	4300563	28.2	1211421	1806722	7473639	15175653	4274815	2468093	4866632
2002	2400000	200000	312000	0	60165	0	13.5	4694287	29.6	1388446	1960611	7665905	15580185	4608206	2647595	5126266
2003	2200000	200000	286000	0	63174	0	14.1	5088010	31.1	1580144	2129317	7850692	15984717	4964249	2834931	5372287
2004	2000000	200000	260000	0	66332	0	14.8	5481734	32.6	1787540	2313873	8028394	16389249	5344375	3030502	5605025
2005	1800000	200000	234000	0	69649	0	15.6	5875458	34.2	2011726	2515375	8199347	16793782	5750104	3234728	5824868
2006	1600000	200000	208000	0	73132	0	16.4	6269182	36.0	2253862	2734994	8363841	17198314	6183044	3448050	6032249
2007	1400000	200000	182000	0	76788	0	17.2	6662906	37.7	2515182	2973970	8522132	17602846	6644903	3670933	6227635
2008	1200000	200000	156000	0	80627	0	18.0	7056630	39.6	2797000	3233627	8674442	18007378	7137490	3903863	6411515
2009	1000000	200000	130000	0	84659	0	18.9	7450354	41.6	3100711	3515370	8820973	18411910	7662724	4147355	6584390
2010	800000	200000	104000	0	88892	0	19.9	7844078	43.7	3427801	3820692	8961910	18816442	8222638	4401946	6746768
2011	600000	200000	78000	0	93336	0	20.9	8237802	45.9	3779848	4151184	9097421	19220974	8819386	4668202	6899157
2012	400000	200000	52000	0	98003	0	21.9	8631526	48.2	4158530	4508533	9227666	19625506	9455252	4946719	7042060
2013	200000	200000	26000	0	102903	0	23.0	9025249	50.6	4565631	4894534	9352795	20030039	10132657	5238123	7175973

CAPITAL COST HYDRO ($)	6000000
LIFETIME (YEARS)	30
RETURN/DISCOUNT RATE	13%
INFLATION RATE	5%
FUEL ESCALATION RATE	6%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH FORK ONLY - 2000 KW INSTALLATION
CASE C - 70 KW ADDED TO YEARLY PEAK

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/kW.h)	DIESEL ENERGY	DIESEL (C/kW.h)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	6000000	200000	780000	0	25000	172144	5.6	199048	12.3	34086	1039086	919545	8235788	1012178	-26908	-23812
1985	5800000	200000	754000	0	26250	136491	5.9	307582	13.0	48158	1028408	1724939	8703139	1133793	105385	58720
1986	5600000	200000	728000	0	27563	79857	6.3	424685	13.8	63661	1019223	2431312	9107671	1257682	238459	223984
1987	5400000	200000	702000	0	28941	32078	6.7	551923	14.6	82924	1013864	3053134	9512203	1392357	378493	456121
1988	5200000	200000	676000	0	30388	4597	7.1	682940	15.5	106288	1012676	3602774	9916736	1538665	525989	741607
1989	5000000	200000	650000	0	31907	0	7.5	824142	16.4	135545	1017452	4091475	10321268	1697517	680066	1068255
1990	4800000	200000	624000	0	33502	0	7.9	976796	17.4	170291	1027793	4528349	10725800	1869893	842100	1426198
1991	4600000	200000	598000	0	35178	0	8.4	1139423	18.5	210561	1043739	4920962	11130332	2056843	1013104	1807287
1992	4400000	200000	572000	0	36936	0	8.9	1294060	19.6	253486	1062422	5274626	11534864	2259494	1197072	2205775
1993	4200000	200000	546000	0	38783	0	9.4	1513617	20.8	314283	1099066	5598398	11939396	2479060	1379994	2612305
1994	4000000	200000	520000	0	40722	0	10.0	1753909	22.0	386027	1146749	5897353	12343928	2716839	1570090	3021623
1995	3800000	200000	494000	0	42758	0	10.6	2047350	23.3	477649	1214407	6177524	12748460	2974227	1759820	3427624
1996	3600000	200000	468000	0	44896	0	11.2	2388706	24.7	590724	1303621	6443677	13152993	3252721	1949100	3825561
1997	3400000	200000	442000	0	47141	0	11.9	2734511	26.2	716816	1405957	6697700	13557525	3553927	2147970	4213649
1998	3200000	200000	416000	0	49498	0	12.6	3119391	27.8	866770	1532268	6942696	13962057	3879568	2347300	4588961
1999	3000000	200000	390000	0	51973	0	13.4	3513115	29.5	1034742	1676716	7179945	14366589	4231492	2554776	4950452
2000	2800000	200000	364000	0	54572	0	14.2	3906839	31.2	1219751	1838323	7410136	14771121	4611680	2773357	5297726
2001	2600000	200000	338000	0	57300	0	15.1	4300563	33.1	1423236	2018536	7633814	15175653	5022258	3003721	5630575
2002	2400000	200000	312000	0	60165	0	16.0	4694287	35.1	1646748	2218913	7851410	15580185	5465502	3246589	5948949
2003	2200000	200000	286000	0	63174	0	16.9	5088010	37.2	1891957	2441131	8063257	15984717	5943856	3502725	6252923
2004	2000000	200000	260000	0	66332	0	17.9	5481734	39.4	2160664	2686996	8269614	16389249	6459937	3772940	6542679
2005	1800000	200000	234000	0	69649	0	19.0	5875458	41.8	2454804	2958453	8470680	16793782	7016549	4058096	6818481
2006	1600000	200000	208000	0	73132	0	20.1	6269182	44.3	2776462	3257594	8666607	17198314	7616699	4359105	7080657
2007	1400000	200000	182000	0	76788	0	21.4	6662906	46.9	3127883	3586671	8857508	17602846	8263607	4676936	7329588
2008	1200000	200000	156000	0	80627	0	22.6	7056630	49.8	3511478	3948106	9043471	18007378	8960725	5012619	7565692
2009	1000000	200000	130000	0	84659	0	24.0	7450354	52.7	3929845	4344504	9224564	18411910	9711747	5367243	7789416
2010	800000	200000	104000	0	88892	0	25.4	7844078	55.9	4385774	4778666	9400838	18816442	10520633	5741967	8001224
2011	600000	200000	78000	0	93336	0	27.0	8237802	59.3	4882268	5253604	9572337	19220974	11391624	6138020	8201593
2012	400000	200000	52000	0	98003	0	28.6	8631526	62.8	5422551	5772555	9739097	19625506	12329259	6556705	8391007
2013	200000	200000	26000	0	102903	0	30.3	9025249	66.6	6010093	6338996	9901154	20030039	13338401	6999404	8569947

CAPITAL COST HYDRO ($)	6000000
LIFETIME (YEARS)	30
RETURN/DISCOUNT RATE	10%
INFLATION RATE	5%
FUEL ESCALATION RATE	5%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH FORK ONLY - 2000 KW INSTALLATION
CASE C - 70 KW ADDED TO YEARLY PEAK

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/kW.h)	DIESEL ENERGY	DIESEL (C/kW.h)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	6000000	200000	600000	0	25000	172144	5.6	199048	12.3	34086	859086	780987	8235788	1012178	153092	139175
1985	5800000	200000	580000	0	26250	136491	5.9	307582	12.9	47703	853953	1486734	8703139	1123097	269143	361607
1986	5600000	200000	560000	0	27563	79857	6.2	424685	13.5	62465	850028	2125372	9107671	1234064	384037	650140
1987	5400000	200000	540000	0	28941	32078	6.5	551923	14.2	80599	849540	2705619	9512203	1353321	503782	994230
1988	5200000	200000	520000	0	30388	4597	6.8	682940	14.9	102334	852721	3235092	9916736	1481419	628697	1384601
1989	5000000	200000	500000	0	31907	0	7.1	824142	15.7	129271	861178	3721204	10321268	1618942	757765	1812339
1990	4800000	200000	480000	0	33502	0	7.5	976796	16.5	160876	874379	4169899	10725800	1766515	892137	2270147
1991	4600000	200000	460000	0	35178	0	7.9	1139423	17.3	197043	892221	4586127	11130332	1924798	1032577	2751851
1992	4400000	200000	440000	0	36936	0	8.3	1294060	18.2	234975	911911	4972866	11534864	2094492	1182581	3253381
1993	4200000	200000	420000	0	38783	0	8.7	1513617	19.1	288584	947367	5338117	11939396	2276344	1328977	3765760
1994	4000000	200000	400000	0	40722	0	9.1	1753909	20.0	351117	991839	5685750	12343928	2471145	1479306	4284247
1995	3800000	200000	380000	0	42758	0	9.6	2047350	21.0	430354	1053113	6021305	12748460	2679735	1626622	4802539
1996	3600000	200000	360000	0	44896	0	10.0	2388706	22.1	527213	1132109	6349236	13152993	2903007	1770897	5315505
1997	3400000	200000	340000	0	47141	0	10.5	2734511	23.2	633713	1220854	6670725	13557525	3141906	1921052	5821378
1998	3200000	200000	320000	0	49498	0	11.1	3119391	24.3	759053	1328551	6988770	13962057	3397437	2068887	6316653
1999	3000000	200000	300000	0	51973	0	11.6	3513115	25.6	897602	1449575	7304240	14366589	3670667	2221092	6800028
2000	2800000	200000	280000	0	54572	0	12.2	3906839	26.8	1048108	1582680	7617365	14771121	3962727	2380047	7270907
2001	2600000	200000	260000	0	57300	0	12.8	4300563	28.2	1211421	1728722	7928290	15175653	4274815	2546093	7728844
2002	2400000	200000	240000	0	60165	0	13.5	4694287	29.6	1388446	1888611	8237093	15580185	4608206	2719595	8173520
2003	2200000	200000	220000	0	63174	0	14.1	5088010	31.1	1580144	2063317	8543792	15984717	4964249	2900931	8604725
2004	2000000	200000	200000	0	66332	0	14.8	5481734	32.6	1787540	2253873	8848359	16389249	5344375	3090502	9022346
2005	1800000	200000	180000	0	69649	0	15.6	5875458	34.2	2011726	2461375	9150729	16793782	5750104	3288728	9426353
2006	1600000	200000	160000	0	73132	0	16.4	6269182	36.0	2253862	2686994	9450808	17198314	6183044	3496050	9816786
2007	1400000	200000	140000	0	76788	0	17.2	6662906	37.7	2515182	2931970	9748478	17602846	6644903	3712933	10193743
2008	1200000	200000	120000	0	80627	0	18.0	7056630	39.6	2797000	3197627	10043606	18007378	7137490	3939863	10557377
2009	1000000	200000	100000	0	84659	0	18.9	7450354	41.6	3100711	3485370	10336048	18411910	7662724	4177355	10907880
2010	800000	200000	80000	0	88892	0	19.9	7844078	43.7	3427801	3796692	10625651	18816442	8222638	4425946	11245481
2011	600000	200000	60000	0	93336	0	20.9	8237802	45.9	3779848	4133184	10912259	19220974	8819386	4686202	11570438
2012	400000	200000	40000	0	98003	0	21.9	8631526	48.2	4158530	4496533	11195718	19625506	9455252	4958719	11883032
2013	200000	200000	20000	0	102903	0	23.0	9025249	50.6	4565631	4888534	11475873	20030039	10132657	5244123	12183565

ECONOMIC ANALYSIS

NORTH FORK AND SOUTH FORK
2000 kW INSTALLATION
CASE A

Page	Return/Discount Rate	Inflation Rate	Fuel Escalation Rate
B-39	13%	5%	4%
B-40	13%	5%	5%
B-41	13%	5%	6%
B-42	10%	5%	5%

CAPITAL COST HYDRO ($)	9600000
LIFETIME (YEARS)	30
RETURN/DISCOUNT RATE	13%
INFLATION RATE	5%
FUEL ESCALATION RATE	4%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH AND SOUTH FORK - 2000 kW INSTALLATION
CASE A - 0 % LOAD GROWTH

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/kW.h)	DIESEL ENERGY	DIESEL (C/kW.h)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	9600000	320000	1248000	0	25000	3272	5.6	0	12.3	183	1593183	1409896	8235788	1012178	-581005	-514163
1985	9280000	320000	1206400	0	26250	3272	5.8	0	12.8	190	1552840	2625998	8235788	1052665	-500175	-905874
1986	8960000	320000	1164800	0	27563	3272	6.0	0	13.3	198	1512560	3674278	8235788	1094772	-417788	-1195422
1987	8640000	320000	1123200	0	28941	3272	6.3	0	13.8	206	1472346	4577296	8235788	1138563	-333783	-1400137
1988	8320000	320000	1081600	0	30388	3272	6.5	0	14.4	214	1432202	5354637	8235788	1184106	-248096	-1534794
1989	8000000	320000	1040000	0	31907	3272	6.8	0	15.0	223	1392130	6023303	8235788	1231470	-160660	-1611962
1990	7680000	320000	998400	0	33502	3272	7.1	0	15.6	231	1352134	6598042	8235788	1280729	-71405	-1642313
1991	7360000	320000	956800	0	35178	3272	7.4	0	16.2	241	1312218	7091646	8235788	1331958	19739	-1634888
1992	7040000	320000	915200	0	36936	3272	7.7	0	16.8	250	1272387	7515204	8235788	1385236	112849	-1597322
1993	6720000	320000	873600	0	38783	3272	8.0	0	17.5	260	1232644	7878326	8235788	1440645	208002	-1536048
1994	6400000	320000	832000	0	40722	3272	8.3	0	18.2	271	1192993	8189337	8235788	1498271	305278	-1456462
1995	6080000	320000	790400	0	42758	3272	8.6	0	18.9	282	1153440	8455442	8235788	1558202	404762	-1363081
1996	5760000	320000	748800	0	44896	3272	8.9	0	19.7	293	1113989	8682879	8235788	1620530	506541	-1259664
1997	5440000	320000	707200	0	47141	3272	9.3	0	20.5	305	1074646	8877043	8235788	1685351	610706	-1149323
1998	5120000	320000	665600	0	49498	3272	9.7	0	21.3	317	1035415	9042596	8235788	1752765	717350	-1034626
1999	4800000	320000	624000	0	51973	3272	10.1	0	22.1	329	996303	9183569	8235788	1822876	826573	-917669
2000	4480000	320000	582400	0	54572	3272	10.5	0	23.0	343	957314	9303442	8235788	1895791	938477	-800155
2001	4160000	320000	540800	0	57300	3272	10.9	0	23.9	356	918457	9405218	8235788	1971623	1053166	-683451
2002	3840000	320000	499200	0	60165	3272	11.3	0	24.9	371	879736	9491489	8235788	2050488	1170752	-568642
2003	3520000	320000	457600	0	63174	3272	11.8	0	25.9	385	841159	9564486	8235788	2132507	1291348	-456576
2004	3200000	320000	416000	0	66332	3272	12.2	0	26.9	401	802733	9626135	8235788	2217807	1415074	-347901
2005	2880000	320000	374400	0	69649	3272	12.7	0	28.0	417	764466	9678091	8235788	2306520	1542054	-243098
2006	2560000	320000	332800	0	73132	3272	13.2	0	29.1	433	726365	9721778	8235788	2398780	1672415	-142511
2007	2240000	320000	291200	0	76788	3272	13.8	0	30.3	451	688439	9758420	8235788	2494732	1806293	-46371
2008	1920000	320000	249600	0	80627	3272	14.3	0	31.5	469	650696	9789069	8235788	2594521	1943825	45187
2009	1600000	320000	208000	0	84659	3272	14.9	0	32.8	488	613146	9814627	8235788	2698302	2085155	132103
2010	1280000	320000	166400	0	88892	3272	15.5	0	34.1	507	575799	9835867	8235788	2806234	2230435	214379
2011	960000	320000	124800	0	93336	3272	16.1	0	35.4	527	538664	9853451	8235788	2918483	2379819	292066
2012	640000	320000	83200	0	98003	3272	16.8	0	36.9	548	501752	9867946	8235788	3035223	2533471	365254
2013	320000	320000	41600	0	102903	3272	17.4	0	38.3	570	465074	9879835	8235788	3156631	2691558	434064

CAPITAL COST HYDRO ($) 9600000
LIFETIME (YEARS) 30
RETURN/DISCOUNT RATE 13%
INFLATION RATE 5%
FUEL ESCALATION RATE 5%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH AND SOUTH FORK - 2000 kW INSTALLATION
CASE A - 0 % LOAD GROWTH

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/kW.h)	DIESEL ENERGY	DIESEL (C/kW.h)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	9600000	320000	1248000	0	25000	3272	5.6	0	12.3	183	1593183	1409896	8235788	1012178	-581005	-514163
1985	9280000	320000	1206400	0	26250	3272	5.9	0	12.9	192	1552842	2625999	8235788	1062787	-490055	-897948
1986	8960000	320000	1164800	0	27563	3272	6.2	0	13.5	202	1512564	3674282	8235788	1115927	-396638	-1172838
1987	8640000	320000	1123200	0	28941	3272	6.5	0	14.2	212	1472352	4577304	8235788	1171723	-300629	-1357219
1988	8320000	320000	1081600	0	30388	3272	6.8	0	14.9	222	1432210	5354650	8235788	1230309	-201901	-1466803
1989	8000000	320000	1040000	0	31907	3272	7.1	0	15.7	233	1392140	6023321	8235788	1291825	-100316	-1514987
1990	7680000	320000	998400	0	33502	3272	7.5	0	16.5	245	1352148	6598065	8235788	1356416	4268	-1513172
1991	7360000	320000	956800	0	35178	3272	7.9	0	17.3	257	1312235	7091675	8235788	1424237	112002	-1471042
1992	7040000	320000	915200	0	36936	3272	8.3	0	18.2	270	1272407	7515240	8235788	1495448	223042	-1396795
1993	6720000	320000	873600	0	38783	3272	8.7	0	19.1	284	1232667	7878370	8235788	1570221	337554	-1297355
1994	6400000	320000	832000	0	40722	3272	9.1	0	20.0	298	1193020	8189387	8235788	1648732	455712	-1178552
1995	6080000	320000	790400	0	42758	3272	9.6	0	21.0	313	1153471	8455500	8235788	1731168	577697	-1045274
1996	5760000	320000	748800	0	44896	3272	10.0	0	22.1	328	1114025	8682944	8235788	1817727	703702	-901603
1997	5440000	320000	707200	0	47141	3272	10.5	0	23.2	345	1074686	8877115	8235788	1908613	833927	-750932
1998	5120000	320000	665600	0	49498	3272	11.1	0	24.3	362	1035460	9042675	8235788	2004044	968583	-596065
1999	4800000	320000	624000	0	51973	3272	11.6	0	25.6	380	996353	9183656	8235788	2104246	1107893	-439302
2000	4480000	320000	582400	0	54572	3272	12.2	0	26.8	399	957371	9303536	8235788	2209458	1252087	-282518
2001	4160000	320000	540800	0	57300	3272	12.8	0	28.2	419	918520	9405319	8235788	2319931	1401412	-127225
2002	3840000	320000	499200	0	60165	3272	13.5	0	29.6	440	879806	9491596	8235788	2435928	1556122	25375
2003	3520000	320000	457600	0	63174	3272	14.1	0	31.1	462	841236	9564601	8235788	2557724	1716488	174336
2004	3200000	320000	416000	0	66332	3272	14.8	0	32.6	485	802818	9626256	8235788	2685610	1882793	318931
2005	2880000	320000	374400	0	69649	3272	15.6	0	34.2	510	764559	9678218	8235788	2819891	2055332	458619
2006	2560000	320000	332800	0	73132	3272	16.4	0	36.0	535	726467	9721911	8235788	2960886	2234419	593007
2007	2240000	320000	291200	0	76788	3272	17.2	0	37.7	562	688550	9758559	8235788	3108930	2420380	721832
2008	1920000	320000	249600	0	80627	3272	18.0	0	39.6	590	650817	9789214	8235788	3264376	2613559	844935
2009	1600000	320000	208000	0	84659	3272	18.9	0	41.6	619	613278	9814777	8235788	3427595	2814317	962245
2010	1280000	320000	166400	0	88892	3272	19.9	0	43.7	650	575942	9836022	8235788	3598975	3023033	1073758
2011	960000	320000	124800	0	93336	3272	20.9	0	45.9	683	538819	9853611	8235788	3778924	3240104	1179528
2012	640000	320000	83200	0	98003	3272	21.9	0	48.2	717	501920	9868111	8235788	3967870	3465950	1279654
2013	320000	320000	41600	0	102903	3272	23.0	0	50.6	753	465256	9880005	8235788	4166263	3701007	1374270

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH AND SOUTH FORK - 2000 kW INSTALLATION
CASE A - 0 % LOAD GROWTH

CAPITAL COST HYDRO ($)	9600000
LIFETIME (YEARS)	30
RETURN/DISCOUNT RATE	13%
INFLATION RATE	5%
FUEL ESCALATION RATE	6%

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/kW.h)	DIESEL ENERGY	DIESEL (C/kW.h)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	9600000	320000	1248000	0	25000	3272	5.6	0	12.3	183	1593183	1409896	8235788	1012178	-581005	-514163
1985	9280000	320000	1206400	0	26250	3272	5.9	0	13.0	194	1552844	2626001	8235788	1072909	-479935	-890023
1986	8960000	320000	1164800	0	27563	3272	6.3	0	13.8	206	1512568	3674286	8235788	1137284	-375284	-1150114
1987	8640000	320000	1123200	0	28941	3272	6.7	0	14.6	218	1472358	4577311	8235788	1205521	-266838	-1313770
1988	8320000	320000	1081600	0	30388	3272	7.1	0	15.5	231	1432219	5354662	8235788	1277852	-154367	-1397554
1989	8000000	320000	1040000	0	31907	3272	7.5	0	16.4	245	1392152	6023339	8235788	1354523	-37629	-1415628
1990	7680000	320000	998400	0	33502	3272	7.9	0	17.4	259	1352162	6598089	8235788	1435794	83632	-1380079
1991	7360000	320000	956800	0	35178	3272	8.4	0	18.5	275	1312253	7091706	8235788	1521942	209689	-1301203
1992	7040000	320000	915200	0	36936	3272	8.9	0	19.6	292	1272428	7515278	8235788	1613259	340831	-1187745
1993	6720000	320000	873600	0	38783	3272	9.4	0	20.8	309	1232692	7878415	8235788	1710054	477362	-1047120
1994	6400000	320000	832000	0	40722	3272	10.0	0	22.0	328	1193050	8189440	8235788	1812657	619607	-885590
1995	6080000	320000	790400	0	42758	3272	10.6	0	23.3	347	1153506	8455561	8235788	1921417	767911	-708428
1996	5760000	320000	748800	0	44896	3272	11.2	0	24.7	368	1114064	8683013	8235788	2036702	922637	-520058
1997	5440000	320000	707200	0	47141	3272	11.9	0	26.2	390	1074731	8877192	8235788	2158904	1084172	-324174
1998	5120000	320000	665600	0	49498	3272	12.6	0	27.8	414	1035512	9042761	8235788	2288438	1252926	-123843
1999	4800000	320000	624000	0	51973	3272	13.4	0	29.5	438	996412	9183749	8235788	2425744	1429333	78403
2000	4480000	320000	582400	0	54572	3272	14.2	0	31.2	465	957437	9303637	8235788	2571289	1613852	280486
2001	4160000	320000	540800	0	57300	3272	15.1	0	33.1	493	918593	9405429	8235788	2725566	1806973	480721
2002	3840000	320000	499200	0	60165	3272	16.0	0	35.1	522	879888	9491714	8235788	2889100	2009213	677752
2003	3520000	320000	457600	0	63174	3272	16.9	0	37.2	553	841327	9564726	8235788	3062446	2221119	870506
2004	3200000	320000	416000	0	66332	3272	17.9	0	39.4	587	802919	9626389	8235788	3246193	2443274	1058146
2005	2880000	320000	374400	0	69649	3272	19.0	0	41.8	622	764671	9678359	8235788	3440965	2676294	1240035
2006	2560000	320000	332800	0	73132	3272	20.1	0	44.3	659	726591	9722059	8235788	3647423	2920832	1415707
2007	2240000	320000	291200	0	76788	3272	21.4	0	46.9	699	688687	9758715	8235788	3866268	3177581	1584835
2008	1920000	320000	249600	0	80627	3272	22.6	0	49.8	741	650968	9789377	8235788	4098244	3447276	1747208
2009	1600000	320000	208000	0	84659	3272	24.0	0	52.7	785	613444	9814947	8235788	4344139	3730695	1902715
2010	1280000	320000	166400	0	88892	3272	25.4	0	55.9	832	576124	9836199	8235788	4604787	4028663	2051324
2011	960000	320000	124800	0	93336	3272	27.0	0	59.3	882	539018	9853795	8235788	4881074	4342056	2193066
2012	640000	320000	83200	0	98003	3272	28.6	0	62.8	935	502138	9868301	8235788	5173939	4671800	2328027
2013	320000	320000	41600	0	102903	3272	30.3	0	66.6	991	465494	9880201	8235788	5484375	5018880	2456335

CAPITAL COST HYDRO ($) 9600000
LIFETIME (YEARS) 30
RETURN/DISCOUNT RATE 10%
INFLATION RATE 5%
FUEL ESCALATION RATE 5%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH AND SOUTH FORK - 2000 kW INSTALLATION
CASE A - 0 % LOAD GROWTH

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/kW.h)	DIESEL ENERGY	DIESEL (C/kW.h)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	9600000	320000	960000	0	25000	3272	5.6	0	12.3	183	1305183	1186530	8235788	1012178	-293005	-266368
1985	9280000	320000	928000	0	26250	3272	5.9	0	12.9	192	1274442	2239788	8235788	1062787	-211655	-441289
1986	8960000	320000	896000	0	27563	3272	6.2	0	13.5	202	1243764	3174246	8235788	1115927	-127838	-537335
1987	8640000	320000	864000	0	28941	3272	6.5	0	14.2	212	1213152	4002846	8235788	1171723	-41429	-565632
1988	8320000	320000	832000	0	30388	3272	6.8	0	14.9	222	1182610	4737153	8235788	1230309	47699	-536015
1989	8000000	320000	800000	0	31907	3272	7.1	0	15.7	233	1152140	5387507	8235788	1291825	139684	-457167
1990	7680000	320000	768000	0	33502	3272	7.5	0	16.5	245	1121748	5963140	8235788	1356416	234668	-336745
1991	7360000	320000	736000	0	35178	3272	7.9	0	17.3	257	1091435	6472303	8235788	1424237	332802	-181490
1992	7040000	320000	704000	0	36936	3272	8.3	0	18.2	270	1061207	6922358	8235788	1495448	434242	2671
1993	6720000	320000	672000	0	38783	3272	8.7	0	19.1	284	1031067	7319879	8235788	1570221	539154	210538
1994	6400000	320000	640000	0	40722	3272	9.1	0	20.0	298	1001020	7670731	8235788	1648732	647712	437557
1995	6080000	320000	608000	0	42758	3272	9.6	0	21.0	313	971071	7980144	8235788	1731168	760097	679747
1996	5760000	320000	576000	0	44896	3272	10.0	0	22.1	328	941225	8252783	8235788	1817727	876502	933638
1997	5440000	320000	544000	0	47141	3272	10.5	0	23.2	345	911486	8492806	8235788	1908613	997127	1196213
1998	5120000	320000	512000	0	49498	3272	11.1	0	24.3	362	881860	8703916	8235788	2004044	1122183	1464855
1999	4800000	320000	480000	0	51973	3272	11.6	0	25.6	380	852353	8889413	8235788	2104246	1251893	1737303
2000	4480000	320000	448000	0	54572	3272	12.2	0	26.8	399	822971	9052234	8235788	2209458	1386487	2011612
2001	4160000	320000	416000	0	57300	3272	12.8	0	28.2	419	793720	9194991	8235788	2319931	1526212	2286115
2002	3840000	320000	384000	0	60165	3272	13.5	0	29.6	440	764606	9320010	8235788	2435928	1671322	2559390
2003	3520000	320000	352000	0	63174	3272	14.1	0	31.1	462	735636	9429358	8235788	2557724	1822088	2830231
2004	3200000	320000	320000	0	66332	3272	14.8	0	32.6	485	706818	9524871	8235788	2685610	1978793	3097627
2005	2880000	320000	288000	0	69649	3272	15.6	0	34.2	510	678159	9608180	8235788	2819891	2141732	3360730
2006	2560000	320000	256000	0	73132	3272	16.4	0	36.0	535	649667	9680733	8235788	2960886	2311219	3618843
2007	2240000	320000	224000	0	76788	3272	17.2	0	37.7	562	621350	9743816	8235788	3108930	2487580	3871396
2008	1920000	320000	192000	0	80627	3272	18.0	0	39.6	590	593217	9798568	8235788	3264376	2671159	4117933
2009	1600000	320000	160000	0	84659	3272	18.9	0	41.6	619	565278	9845998	8235788	3427595	2862317	4358097
2010	1280000	320000	128000	0	88892	3272	19.9	0	43.7	650	537542	9887000	8235788	3598975	3061433	4591616
2011	960000	320000	96000	0	93336	3272	20.9	0	45.9	683	510019	9922367	8235788	3778924	3268904	4818293
2012	640000	320000	64000	0	98003	3272	21.9	0	48.2	717	482720	9952797	8235788	3967870	3485150	5037994
2013	320000	320000	32000	0	102903	3272	23.0	0	50.6	753	455656	9978910	8235788	4166263	3710607	5250644

ECONOMIC ANALYSIS

NORTH FORK AND SOUTH FORK
2000 kW INSTALLATION
CASE B

Page	Return/Discount Rate	Inflation Rate	Fuel Escalation Rate
B-44	13%	5%	4%
B-45	13%	5%	5%
B-46	13%	5%	6%
B-47	10%	5%	5%

CAPITAL COST HYDRO ($) 9600000
LIFETIME (YEARS) 30
RETURN/DISCOUNT RATE 13%
INFLATION RATE 5%
FUEL ESCALATION RATE 4%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH AND SOUTH FORK - 2000 kW INSTALLATION
CASE B - 1.6% LOAD GROWTH

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/kW.h)	DIESEL ENERGY	DIESEL (C/kW.h)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	9600000	320000	1248000	0	25000	3272	5.6	0	12.3	183	1593183	1409896	8235788	1012178	-581005	-514163
1985	9280000	320000	1206400	0	26250	15483	5.8	0	12.8	900	1553550	2626554	8369557	1069763	-483787	-893039
1986	8960000	320000	1164800	0	27563	12378	6.0	0	13.3	748	1513111	3675216	8503470	1130355	-382756	-1158309
1987	8640000	320000	1123200	0	28941	6606	6.3	0	13.8	415	1472556	4578362	8639525	1194378	-278178	-1328921
1988	8320000	320000	1081600	0	30388	1247	6.5	0	14.4	82	1432069	5355632	8777758	1262028	-170042	-1421212
1989	8000000	320000	1040000	0	31907	14562	6.8	0	15.0	990	1392897	6024666	8918202	1333509	-59389	-1449738
1990	7680000	320000	998400	0	33502	11623	7.1	0	15.6	822	1352724	6599656	9060893	1409039	56314	-1425801
1991	7360000	320000	956800	0	35178	4567	7.4	0	16.2	336	1312313	7093296	9205867	1488847	176533	-1359396
1992	7040000	320000	915200	0	36936	23086	7.7	0	16.8	1766	1273903	7517359	9353161	1573175	299272	-1259773
1993	6720000	320000	873600	0	38783	0	8.0	0	17.5	0	1232383	7880404	9502812	1662280	429896	-1133130
1994	6400000	320000	832000	0	40722	9657	8.3	0	18.2	799	1193521	8191553	9654857	1756431	562910	-986381
1995	6080000	320000	790400	0	42758	12562	8.6	0	18.9	1081	1154240	8457842	9809334	1855915	701676	-824501
1996	5760000	320000	748800	0	44896	1674	8.9	0	19.7	150	1113846	8685250	9966284	1961034	847188	-651535
1997	5440000	320000	707200	0	47141	24184	9.3	0	20.5	2251	1076592	8879765	10125744	2072107	995515	-471669
1998	5120000	320000	665600	0	49498	0	9.7	0	21.3	0	1035098	9045268	10287756	2189471	1154373	-287095
1999	4800000	320000	624000	0	51973	9896	10.1	0	22.1	996	996969	9186335	10452360	2313483	1316514	-100813
2000	4480000	320000	582400	0	54572	0	10.5	0	23.0	0	956972	9306165	10619598	2444519	1487547	85454
2001	4160000	320000	540800	0	57300	4079	10.9	0	23.9	444	918545	9407951	10789512	2582976	1664432	269894
2002	3840000	320000	499200	0	60165	0	11.3	0	24.9	0	879365	9494185	10962144	2729276	1849911	451303
2003	3520000	320000	457600	0	63174	0	11.8	0	25.9	0	840774	9567150	11137538	2883862	2043089	628607
2004	3200000	320000	416000	0	66332	15677	12.2	0	26.9	1920	804253	9628915	11315739	3047204	2242952	800863
2005	2880000	320000	374400	0	69649	0	12.7	2191	28.0	614	764663	9680884	11496790	3219798	2455135	967722
2006	2560000	320000	332800	0	73132	12197	13.2	35044	29.1	11823	737754	9725256	11680739	3402167	2664413	1127971
2007	2240000	320000	291200	0	76788	0	13.8	70605	30.3	21387	709375	9763013	11867631	3594866	2885491	1281552
2008	1920000	320000	249600	0	80627	9703	14.3	123466	31.5	40286	690513	9795537	12057513	3798479	3107966	1427944
2009	1600000	320000	208000	0	84659	0	14.9	193730	32.8	63472	676131	9823720	12250433	4013625	3337494	1567061
2010	1280000	320000	166400	0	88892	8223	15.5	270660	34.1	93498	668790	9848391	12446440	4240957	3572167	1698830
2011	960000	320000	124800	0	93336	0	16.1	387555	35.4	137336	675473	9870441	12645583	4481165	3805692	1823063
2012	640000	320000	83200	0	98003	7790	16.8	528327	36.9	196016	697219	9890582	12847913	4734978	4037759	1939708
2013	320000	320000	41600	0	102903	0	17.4	671352	38.3	257317	721821	9909036	13053479	5003167	4281346	2049161

27-Mar-85

CAPITAL COST HYDRO ($)	9600000
LIFETIME (YEARS)	30
RETURN/DISCOUNT RATE	13%
INFLATION RATE	5%
FUEL ESCALATION RATE	5%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH AND SOUTH FORK - 2000 kW INSTALLATION
CASE B - 1.6% LOAD GROWTH

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/kW.h)	DIESEL ENERGY	DIESEL (C/kW.h)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	9600000	320000	1248000	0	25000	3272	5.6	0	12.3	183	1593183	1409896	8235788	1012178	-581005	-514163
1985	9280000	320000	1206400	0	26250	15483	5.9	0	12.9	909	1553559	2626561	8369557	1080049	-473509	-884991
1986	8960000	320000	1164800	0	27563	12378	6.2	0	13.5	763	1513125	3675233	8503470	1152197	-360929	-1135132
1987	8640000	320000	1123200	0	28941	6606	6.5	0	14.2	427	1472568	4578386	8639525	1229163	-243405	-1284417
1988	8320000	320000	1081600	0	30388	1247	6.8	0	14.9	85	1432072	5355658	8777758	1311272	-120801	-1349983
1989	8000000	320000	1040000	0	31907	14562	7.1	0	15.7	1039	1392946	6024715	8918202	1398865	5919	-1347140
1990	7680000	320000	998400	0	33502	11623	7.5	0	16.5	871	1352773	6599726	9060893	1492309	139536	-1287829
1991	7360000	320000	956800	0	35178	4567	7.9	0	17.3	359	1312337	7093374	9205867	1591995	279658	-1182633
1992	7040000	320000	915200	0	36936	23086	8.3	0	18.2	1907	1274043	7517484	9353161	1698340	424297	-1041390
1993	6720000	320000	873600	0	38783	0	8.7	0	19.1	0	1232383	7880530	9502812	1811789	579406	-870704
1994	6400000	320000	832000	0	40722	9657	9.1	0	20.0	879	1193602	8191699	9654857	1932817	739215	-677993
1995	6080000	320000	790400	0	42758	12562	9.6	0	21.0	1201	1154360	8458016	9809334	2061929	907569	-468611
1996	5760000	320000	748800	0	44896	1674	10.0	0	22.1	168	1113864	8685428	9966284	2199666	1085801	-246929
1997	5440000	320000	707200	0	47141	24184	10.5	0	23.2	2549	1076890	8879997	10125744	2346604	1269713	-17521
1998	5120000	320000	665600	0	49498	0	11.1	0	24.3	0	1035098	9045500	10287756	2503357	1468258	217240
1999	4800000	320000	624000	0	51973	9896	11.6	0	25.6	1150	997123	9186589	10452360	2670581	1673458	454028
2000	4480000	320000	582400	0	54572	0	12.2	0	26.8	0	956972	9306419	10619598	2848976	1892004	690940
2001	4160000	320000	540800	0	57300	4079	12.8	0	28.2	523	918623	9408213	10789512	3039287	2120664	925936
2002	3840000	320000	499200	0	60165	0	13.5	0	29.6	0	879365	9494448	10962144	3242312	2362946	1157656
2003	3520000	320000	457600	0	63174	0	14.1	0	31.1	0	840774	9567412	11137538	3458898	2618124	1384863
2004	3200000	320000	416000	0	66332	15677	14.8	0	32.6	2325	804658	9629208	11315739	3689952	2885295	1606449
2005	2880000	320000	374400	0	69649	0	15.6	2191	34.2	750	764799	9681187	11496790	3936441	3171642	1822004
2006	2560000	320000	332800	0	73132	12197	16.4	35044	36.0	14593	740525	9725725	11680739	4199396	3458871	2030036
2007	2240000	320000	291200	0	76788	0	17.2	70605	37.7	26653	714641	9763762	11867631	4479915	3765274	2230444
2008	1920000	320000	249600	0	80627	9703	18.0	123466	39.6	50687	700914	9796776	12057513	4779174	4078259	2422538
2009	1600000	320000	208000	0	84659	0	18.9	193730	41.6	80627	693286	9825675	12250433	5098422	4405136	2606158
2010	1280000	320000	166400	0	88892	8223	19.9	270660	43.7	119911	695202	9851319	12446440	5438997	4743795	2781146
2011	960000	320000	124800	0	93336	0	20.9	387555	45.9	177826	715963	9874691	12645583	5802322	5086359	2947185
2012	640000	320000	83200	0	98003	7790	21.9	528327	48.2	256246	757450	9896573	12847913	6189917	5432467	3104121
2013	320000	320000	41600	0	102903	0	23.0	671352	50.6	339619	804122	9917130	13053479	6603404	5799281	3252380

CAPITAL COST HYDRO ($)	9600000
LIFETIME (YEARS)	30
RETURN/DISCOUNT RATE	13%
INFLATION RATE	5%
FUEL ESCALATION RATE	6%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH AND SOUTH FORK - 2000 kW INSTALLATION
CASE B - 1.6% LOAD GROWTH

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/kW.h)	DIESEL ENERGY	DIESEL (C/kW.h)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	9600000	320000	1248000	0	25000	3272	5.6	0	12.3	183	1593183	1409896	8235788	1012178	-581005	-514163
1985	9280000	320000	1206400	0	26250	15483	5.9	0	13.0	917	1553567	2626568	8369557	1090336	-463232	-876942
1986	8960000	320000	1164800	0	27563	12378	6.3	0	13.8	777	1513140	3675249	8503470	1174248	-338892	-1111811
1987	8640000	320000	1123200	0	28941	6606	6.7	0	14.6	440	1472580	4578411	8639525	1264618	-207962	-1239358
1988	8320000	320000	1081600	0	30388	1247	7.1	0	15.5	88	1432076	5355684	8777758	1361943	-70133	-1277423
1989	8000000	320000	1040000	0	31907	14562	7.5	0	16.4	1089	1392996	6024766	8918202	1466758	73762	-1241994
1990	7680000	320000	998400	0	33502	11623	7.9	0	17.4	922	1352824	6599798	9060893	1579640	226816	-1145584
1991	7360000	320000	956800	0	35178	4567	8.4	0	18.5	384	1312361	7093456	9205867	1701209	388847	-999315
1992	7040000	320000	915200	0	36936	23086	8.9	0	19.6	2057	1274193	7517615	9353161	1832134	557941	-813585
1993	6720000	320000	873600	0	38783	0	9.4	0	20.8	0	1232383	7880661	9502812	1973135	740752	-595368
1994	6400000	320000	832000	0	40722	9657	10.0	0	22.0	967	1193689	8191853	9654857	2124987	931298	-352581
1995	6080000	320000	790400	0	42758	12562	10.6	0	23.3	1333	1154492	8458201	9809334	2288526	1134035	-90952
1996	5760000	320000	748800	0	44896	1674	11.2	0	24.7	188	1113885	8685617	9966284	2464651	1350767	184826
1997	5440000	320000	707200	0	47141	24184	11.9	0	26.2	2883	1077225	8880246	10125744	2654331	1577106	469772
1998	5120000	320000	665600	0	49498	0	12.6	0	27.8	0	1035098	9045749	10287756	2858608	1823510	761335
1999	4800000	320000	624000	0	51973	9896	13.4	0	29.5	1326	997299	9186863	10452360	3078607	2081308	1055832
2000	4480000	320000	582400	0	54572	0	14.2	0	31.2	0	956972	9306693	10619598	3315536	2358565	1351167
2001	4160000	320000	540800	0	57300	4079	15.1	0	33.1	614	918715	9408498	10789512	3570700	2651986	1645039
2002	3840000	320000	499200	0	60165	0	16.0	0	35.1	0	879365	9494732	10962144	3845501	2966136	1935910
2003	3520000	320000	457600	0	63174	0	16.9	0	37.2	0	840774	9567696	11137538	4141451	3300677	2222351
2004	3200000	320000	416000	0	66332	15677	17.9	0	39.4	2811	805143	9629530	11315739	4460177	3655034	2503052
2005	2880000	320000	374400	0	69649	0	19.0	2191	41.8	916	764965	9681519	11496790	4803432	4038468	2777519
2006	2560000	320000	332800	0	73132	12197	20.1	35044	44.3	17977	743909	9726261	11680739	5173104	4429196	3043911
2007	2240000	320000	291200	0	76788	0	21.4	70605	46.9	33145	721133	9764644	11867631	5571227	4850093	3302058
2008	1920000	320000	249600	0	80627	9703	22.6	123466	49.8	63634	713862	9798268	12057513	5999988	5286126	3551045
2009	1600000	320000	208000	0	84659	0	24.0	193730	52.7	102187	714846	9828065	12250433	6461747	5746901	3790594
2010	1280000	320000	166400	0	88892	8223	25.4	270660	55.9	153422	728714	9854946	12446440	6959043	6230329	4020417
2011	960000	320000	124800	0	93336	0	27.0	387555	59.3	229691	767827	9880011	12645583	7494611	6726784	4240006
2012	640000	320000	83200	0	98003	7790	28.6	528327	62.8	334135	835338	9904142	12847913	8071397	7236058	4449045
2013	320000	320000	41600	0	102903	0	30.3	671352	66.6	447067	911570	9927447	13053479	8692571	7781001	4647967

CAPITAL COST HYDRO ($) 9600000
LIFETIME (YEARS) 30
RETURN/DISCOUNT RATE 10%
INFLATION RATE 5%
FUEL ESCALATION RATE 5%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH AND SOUTH FORK - 2000 kW INSTALLATION
CASE B - 1.6% LOAD GROWTH

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/kW.h)	DIESEL ENERGY	DIESEL (C/kW.h)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	9600000	320000	960000	0	25000	3272	5.6	0	12.3	183	1305183	1186530	8235788	1012178	-293005	-266368
1985	9280000	320000	928000	0	26250	15483	5.9	0	12.9	909	1275159	2240380	8369557	1080049	-195109	-427615
1986	8960000	320000	896000	0	27563	12378	6.2	0	13.5	763	1244325	3175260	8503470	1152197	-92129	-496833
1987	8640000	320000	864000	0	28941	6606	6.5	0	14.2	427	1213368	4004007	8639525	1229163	15795	-486044
1988	8320000	320000	832000	0	30388	1247	6.8	0	14.9	85	1182472	4738229	8777758	1311272	128799	-406070
1989	8000000	320000	800000	0	31907	14562	7.1	0	15.7	1039	1152946	5389037	8918202	1398865	245919	-267255
1990	7680000	320000	768000	0	33502	11623	7.5	0	16.5	871	1122373	5964992	9060893	1492309	369936	-77420
1991	7360000	320000	736000	0	35178	4567	7.9	0	17.3	359	1091537	6474202	9205867	1591995	500458	156047
1992	7040000	320000	704000	0	36936	23086	8.3	0	18.2	1907	1062843	6924951	9353161	1698340	635497	425560
1993	6720000	320000	672000	0	38783	0	8.7	0	19.1	0	1030783	7322363	9502812	1811789	781006	726672
1994	6400000	320000	640000	0	40722	9657	9.1	0	20.0	879	1001602	7673418	9654857	1932817	931215	1053057
1995	6080000	320000	608000	0	42758	12562	9.6	0	21.0	1201	971960	7983114	9809334	2061929	1089969	1400355
1996	5760000	320000	576000	0	44896	1674	10.0	0	22.1	168	941064	8255707	9966284	2199666	1258601	1764927
1997	5440000	320000	544000	0	47141	24184	10.5	0	23.2	2549	913690	8496310	10125744	2346604	1432913	2142258
1998	5120000	320000	512000	0	49498	0	11.1	0	24.3	0	881498	8707334	10287756	2503357	1621858	2530518
1999	4800000	320000	480000	0	51973	9896	11.6	0	25.6	1150	853123	8892999	10452360	2670581	1817458	2926050
2000	4480000	320000	448000	0	54572	0	12.2	0	26.8	0	822572	9055740	10619598	2848976	2026404	3326963
2001	4160000	320000	416000	0	57300	4079	12.8	0	28.2	523	793823	9198516	10789512	3039287	2245464	3730829
2002	3840000	320000	384000	0	60165	0	13.5	0	29.6	0	764165	9323463	10962144	3242312	2478146	4136026
2003	3520000	320000	352000	0	63174	0	14.1	0	31.1	0	735174	9432742	11137538	3458898	2723724	4540890
2004	3200000	320000	320000	0	66332	15677	14.8	0	32.6	2325	708658	9528503	11315739	3689952	2981295	4943754
2005	2880000	320000	288000	0	69649	0	15.6	2191	34.2	750	678399	9611842	11496790	3936441	3258042	5343992
2006	2560000	320000	256000	0	73132	12197	16.4	35044	36.0	14593	663725	9685966	11680739	4199396	3535671	5738849
2007	2240000	320000	224000	0	76788	0	17.2	70605	37.7	26653	647441	9751697	11867631	4479915	3832474	6127943
2008	1920000	320000	192000	0	80627	9703	18.0	123466	39.6	50687	643314	9811073	12057513	4779174	4135859	6509666
2009	1600000	320000	160000	0	84659	0	18.9	193730	41.6	80627	645286	9865216	12250433	5098422	4453136	6883309
2010	1280000	320000	128000	0	88892	8223	19.9	270660	43.7	119911	656802	9915315	12446440	5438997	4782195	7248084
2011	960000	320000	96000	0	93336	0	20.9	387555	45.9	177826	687163	9962965	12645583	5802322	5115159	7602786
2012	640000	320000	64000	0	98003	7790	21.9	528327	48.2	256246	738250	10009504	12847913	6189917	5451667	7946456
2013	320000	320000	32000	0	102903	0	23.0	671352	50.6	339619	794522	10055037	13053479	6603404	5808881	8279354

ECONOMIC ANALYSIS

NORTH FORK AND SOUTH FORK
2000 kW INSTALLATION
CASE C

Page	Return/Discount Rate	Inflation Rate	Fuel Escalation Rate
B-49	13%	5%	4%
B-50	13%	5%	5%
B-51	13%	5%	6%
B-52	10%	5%	5%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH AND SOUTH FORK - 2000 kW INSTALLATION
CASE C - 70 kW ADDED TO YEARLY PEAK

CAPITAL COST HYDRO ($)	9600000
LIFETIME (YEARS)	30
RETURN/DISCOUNT RATE	13%
INFLATION RATE	5%
FUEL ESCALATION RATE	4%

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/kW.h)	DIESEL ENERGY	DIESEL (C/kW.h)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	9600000	320000	1248000	0	25000	3272	5.8	0	12.3	190	1593190	1409902	8235788	1012178	-581011	-514169
1985	9280000	320000	1206400	0	26250	0	6.0	0	12.8	0	1552650	2625855	8703139	1112400	-440250	-858949
1986	8960000	320000	1164800	0	27563	15806	6.3	0	13.3	992	1513354	3674685	9107671	1210670	-302684	-1068724
1987	8640000	320000	1123200	0	28941	13502	6.5	0	13.8	881	1473022	4578117	9512203	1315022	-158000	-1165628
1988	8320000	320000	1081600	0	30388	11239	6.8	0	14.4	763	1432750	5355757	9916736	1425785	-6965	-1169409
1989	8000000	320000	1040000	0	31907	9015	7.1	0	15.0	636	1392543	6024621	10321268	1543304	150761	-1096996
1990	7680000	320000	998400	0	33502	8313	7.3	0	15.6	610	1352512	6599521	10725800	1667945	315432	-962918
1991	7360000	320000	956800	0	35178	10380	7.6	0	16.2	792	1312770	7093332	11130332	1800086	487317	-779609
1992	7040000	320000	915200	0	36936	12466	7.9	0	16.8	990	1273126	7517136	11534864	1940131	667005	-557573
1993	6720000	320000	873600	0	38783	14572	8.3	68344	17.5	13158	1245541	7884058	11939396	2088499	842958	-309247
1994	6400000	320000	832000	0	40722	35717	8.6	194086	18.2	38375	1231097	8205002	12343928	2245632	1014535	-44760
1995	6080000	320000	790400	0	42758	58069	8.9	398563	18.9	80593	1233751	8489636	12748460	2411995	1178244	227067
1996	5760000	320000	748800	0	44896	28769	9.3	678362	19.7	136151	1249847	8744810	13152993	2588073	1338226	500286
1997	5440000	320000	707200	0	47141	6739	9.7	984550	20.5	202127	1276468	8975438	13557525	2774378	1497910	770923
1998	5120000	320000	665600	0	49498	0	10.0	1318554	21.3	280619	1315717	9185809	13962057	2971447	1655730	1035659
1999	4800000	320000	624000	0	51973	0	10.4	1660747	22.1	367583	1363556	9378747	14366589	3179843	1816286	1292657
2000	4480000	320000	582400	0	54572	0	10.9	2052688	23.0	472507	1429479	9557744	14771121	3400155	1970676	1539421
2001	4160000	320000	540800	0	57300	0	11.3	2454238	23.9	587537	1505638	9724587	15175653	3633005	2127368	1775159
2002	3840000	320000	499200	0	60165	0	11.7	2855788	24.9	711014	1590379	9880546	15580185	3879043	2288664	1999595
2003	3520000	320000	457600	0	63174	0	12.2	3257338	25.9	843428	1684202	10026705	15984717	4138951	2454749	2212623
2004	3200000	320000	416000	0	66332	0	12.7	3658888	26.9	985298	1787631	10163992	16389249	4413445	2625814	2414282
2005	2880000	320000	374400	0	69649	0	13.2	4060438	28.0	1137169	1901218	10293205	16793782	4703276	2802059	2604719
2006	2560000	320000	332800	0	73132	0	13.7	4461988	29.1	1299612	2025544	10415030	17198314	5009233	2983689	2784171
2007	2240000	320000	291200	0	76788	0	14.3	4863538	30.3	1473232	2161220	10530062	17602846	5332140	3170921	2952944
2008	1920000	320000	249600	0	80627	0	14.9	5265088	31.5	1658661	2308889	10638815	18007378	5672866	3363977	3111394
2009	1600000	320000	208000	0	84659	0	15.5	5666638	32.8	1856568	2469227	10741740	18411910	6032318	3563091	3259915
2010	1280000	320000	166400	0	88892	0	16.1	6068188	34.1	2067653	2642945	10839232	18816442	6411449	3768504	3398927
2011	960000	320000	124800	0	93336	0	16.7	6469738	35.4	2292655	2830792	10931641	19220974	6811260	3980468	3528865
2012	640000	320000	83200	0	98003	0	17.4	6871288	36.9	2532349	3033552	11019275	19625506	7232797	4199245	3650175
2013	320000	320000	41600	0	102903	0	18.1	7272838	38.3	2787550	3252053	11102414	20030039	7677159	4425105	3763303

CAPITAL COST HYDRO ($) 9600000
LIFETIME (YEARS) 30
RETURN/DISCOUNT RATE 13%
INFLATION RATE 5%
FUEL ESCALATION RATE 5%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH AND SOUTH FORK - 2000 kW INSTALLATION
CASE C - 70 kW ADDED TO YEARLY PEAK

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/kW.h)	DIESEL ENERGY	DIESEL (C/kW.h)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	9600000	320000	1248000	0	25000	3272	5.8	0	12.3	190	1593190	1409902	8235788	1012178	-581011	-514169
1985	9280000	320000	1206400	0	26250	0	6.1	0	12.9	0	1552650	2625855	8703139	1123097	-429553	-850573
1986	8960000	320000	1164800	0	27563	15806	6.4	0	13.5	1011	1513373	3674699	9107671	1234064	-279309	-1044148
1987	8640000	320000	1123200	0	28941	13502	6.7	0	14.2	907	1473047	4578146	9512203	1353321	-119726	-1117578
1988	8320000	320000	1081600	0	30388	11239	7.0	0	14.9	792	1432780	5355802	9916736	1481419	48639	-1091179
1989	8000000	320000	1040000	0	31907	9015	7.4	0	15.7	667	1392574	6024681	10321268	1618942	226368	-982450
1990	7680000	320000	998400	0	33502	8313	7.8	0	16.5	646	1352549	6599596	10725800	1766515	413967	-806489
1991	7360000	320000	956800	0	35178	10380	8.2	0	17.3	847	1312825	7093428	11130332	1924798	611973	-576289
1992	7040000	320000	915200	0	36936	12466	8.6	0	18.2	1068	1273205	7517259	11534864	2094492	821288	-302895
1993	6720000	320000	873600	0	38783	14572	9.0	68344	19.1	14341	1246725	7884529	11939396	2276344	1029620	419
1994	6400000	320000	832000	0	40722	35717	9.4	194086	20.0	42229	1234951	8206478	12343928	2471145	1236194	322692
1995	6080000	320000	790400	0	42758	58069	9.9	398563	21.0	89539	1242697	8493176	12748460	2679735	1437038	654225
1996	5760000	320000	748800	0	44896	28769	10.4	678362	22.1	152718	1266415	8751733	13152993	2903007	1636592	988359
1997	5440000	320000	707200	0	47141	6739	10.9	984550	23.2	228903	1303244	8987198	13557525	3141906	1838662	1320562
1998	5120000	320000	665600	0	49498	0	11.5	1318554	24.3	320848	1355947	9204001	13962057	3397437	2041491	1646977
1999	4800000	320000	624000	0	51973	0	12.1	1660747	25.6	424321	1420295	9404968	14366589	3670667	2250373	1965397
2000	4480000	320000	582400	0	54572	0	12.7	2052688	26.8	550686	1507657	9593754	14771121	3962727	2455069	2272815
2001	4160000	320000	540800	0	57300	0	13.3	2454238	28.2	691332	1609433	9772098	15175653	4274815	2665383	2568173
2002	3840000	320000	499200	0	60165	0	14.0	2855788	29.6	844667	1724032	9941164	15580185	4608206	2884174	2851006
2003	3520000	320000	457600	0	63174	0	14.7	3257338	31.1	1011606	1852380	10101918	15984717	4964249	3111869	3121061
2004	3200000	320000	416000	0	66332	0	15.4	3658888	32.6	1193128	1995460	10255166	16389249	5344375	3348915	3378253
2005	2880000	320000	374400	0	69649	0	16.2	4060438	34.2	1390273	2154322	10401581	16793782	5750104	3595782	3622634
2006	2560000	320000	332800	0	73132	0	17.0	4461988	36.0	1604150	2330081	10541722	17198314	6183044	3852963	3854368
2007	2240000	320000	291200	0	76788	0	17.8	4863538	37.7	1835938	2523926	10676059	17602846	6644903	4120977	4073708
2008	1920000	320000	249600	0	80627	0	18.7	5265088	39.6	2086896	2737123	10804983	18007378	7137490	4400367	4280974
2009	1600000	320000	208000	0	84659	0	19.6	5666638	41.6	2358359	2971017	10928824	18411910	7662724	4691707	4476539
2010	1280000	320000	166400	0	88892	0	20.6	6068188	43.7	2651751	3227043	11047862	18816442	8222638	4995595	4660815
2011	960000	320000	124800	0	93336	0	21.7	6469738	45.9	2968586	3506723	11162336	19220974	8819386	5312664	4834242
2012	640000	320000	83200	0	98003	0	22.7	6871288	48.2	3310476	3811679	11272450	19625506	9455252	5643573	4997277
2013	320000	320000	41600	0	102903	0	23.9	7272838	50.6	3679133	4143636	11378382	20030039	10132657	5989021	5150386

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH AND SOUTH FORK - 2000 kW INSTALLATION
CASE C - 70 kW ADDED TO YEARLY PEAK

CAPITAL COST HYDRO ($)	9600000
LIFETIME (YEARS)	30
RETURN/DISCOUNT RATE	13%
INFLATION RATE	5%
FUEL ESCALATION RATE	6%

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/kW.h)	DIESEL ENERGY	DIESEL (C/kW.h)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	9600000	320000	1248000	0	25000	3272	5.8	0	12.3	190	1593190	1409902	8235788	1012178	-581011	-514169
1985	9280000	320000	1206400	0	26250	0	6.1	0	13.0	0	1552650	2625855	8703139	1133793	-418857	-842196
1986	8960000	320000	1164800	0	27563	15806	6.5	0	13.8	1030	1513393	3674712	9107671	1257682	-255710	-1019416
1987	8640000	320000	1123200	0	28941	13502	6.9	0	14.6	933	1473073	4578176	9512203	1392357	-80716	-1068921
1988	8320000	320000	1081600	0	30388	11239	7.3	0	15.5	823	1432811	5355848	9916736	1538665	105854	-1011467
1989	8000000	320000	1040000	0	31907	9015	7.8	0	16.4	700	1392607	6024743	10321268	1697517	304911	-865013
1990	7680000	320000	998400	0	33502	8313	8.2	0	17.4	684	1352586	6599674	10725800	1869893	517307	-645126
1991	7360000	320000	956800	0	35178	10380	8.7	0	18.5	905	1312883	7093528	11130332	2056843	743960	-365279
1992	7040000	320000	915200	0	36936	12466	9.2	0	19.6	1152	1273289	7517386	11534864	2259494	986206	-36986
1993	6720000	320000	873600	0	38783	14572	9.8	68344	20.8	15619	1248002	7885033	11939396	2479060	1231058	325670
1994	6400000	320000	832000	0	40722	35717	10.4	194086	22.0	46427	1239150	8208076	12343928	2716839	1477689	710900
1995	6080000	320000	790400	0	42758	58069	11.0	398563	23.3	99379	1252537	8497044	12748460	2974227	1721690	1108104
1996	5760000	320000	748800	0	44896	28769	11.7	678362	24.7	171116	1284812	8759357	13152993	3252721	1967909	1509881
1997	5440000	320000	707200	0	47141	6739	12.4	984550	26.2	258921	1333262	9000246	13557525	3553927	2220665	1911103
1998	5120000	320000	665600	0	49498	0	13.1	1318554	27.8	366380	1401478	9224330	13962057	3879568	2478090	2307327
1999	4800000	320000	624000	0	51973	0	13.9	1660747	29.5	489152	1485125	9434469	14366589	4231492	2746367	2695928
2000	4480000	320000	582400	0	54572	0	14.7	2052688	31.2	640868	1597840	9634547	14771121	4611680	3013840	3073314
2001	4160000	320000	540800	0	57300	0	15.6	2454238	33.1	812210	1730310	9826287	15175653	5022258	3291947	3438103
2002	3840000	320000	499200	0	60165	0	16.6	2855788	35.1	1001806	1881171	10010762	15580185	5465502	3584331	3789596
2003	3520000	320000	457600	0	63174	0	17.5	3257338	37.2	1211229	2052003	10188840	15984717	5943856	3891854	4127340
2004	3200000	320000	416000	0	66332	0	18.6	3658888	39.4	1442176	2244509	10361215	16389249	6459937	4215428	4451079
2005	2880000	320000	374400	0	69649	0	19.7	4060438	41.8	1696477	2460526	10528440	16793782	7016549	4556023	4760721
2006	2560000	320000	332800	0	73132	0	20.9	4461988	44.3	1976102	2702033	10690952	17198314	7616699	4914665	5056311
2007	2240000	320000	291200	0	76788	0	22.2	4863538	46.9	2283175	2971163	10849093	17602846	8263607	5292445	5338003
2008	1920000	320000	249600	0	80627	0	23.5	5265088	49.8	2619982	3270209	11003126	18007378	8960725	5690515	5606037
2009	1600000	320000	208000	0	84659	0	24.9	5666638	52.7	2988987	3601646	11153254	18411910	9711747	6110101	5860725
2010	1280000	320000	166400	0	88892	0	26.4	6068188	55.9	3392840	3968132	11299630	18816442	10520633	6552501	6102432
2011	960000	320000	124800	0	93336	0	28.0	6469738	59.3	3834396	4372532	11442367	19220974	11391624	7019092	6331563
2012	640000	320000	83200	0	98003	0	29.6	6871288	62.8	4316724	4817927	11581550	19625506	12329259	7511332	6548555
2013	320000	320000	41600	0	102903	0	31.4	7272838	66.6	4843127	5307631	11717239	20030039	13338401	8030770	6753862

CAPITAL COST HYDRO ($) 9600000
LIFETIME (YEARS) 30
RETURN/DISCOUNT RATE 10%
INFLATION RATE 5%
FUEL ESCALATION RATE 5%

KLONDIKE HYDROELECTRIC REDEVELOPMENT
NORTH AND SOUTH FORK - 2000 kW INSTALLATION
CASE C - 70 kW ADDED TO YEARLY PEAK

YEAR	RATE BASE	DEPREC.	RETURN	O & M	TRANS. O & M	OIL BOILER ENERGY	OIL BOILER (C/kW.h)	DIESEL ENERGY	DIESEL (C/kW.h)	TOTAL FUEL COST	TOTAL COST (HYDRO & DIESEL)	HYDRO CUMULATIVE PRESENT WORTH	MARKET DEMAND	COST TO SUPPLY ENERGY BY DIESEL	SAVINGS	SAVINGS CUMULATIVE PRESENT WORTH
1984	9600000	320000	960000	0	25000	3272	5.8	0	12.3	190	1305190	1186536	8235788	1012178	-293011	-266374
1985	9280000	320000	928000	0	26250	0	6.1	0	12.9	0	1274250	2239635	8703139	1123097	-151153	-391294
1986	8960000	320000	896000	0	27563	15806	6.4	0	13.5	1011	1244573	3174702	9107671	1234064	-10509	-399190
1987	8640000	320000	864000	0	28941	13502	6.7	0	14.2	907	1213847	4003776	9512203	1353321	139474	-303927
1988	8320000	320000	832000	0	30388	11239	7.0	0	14.9	792	1183180	4738437	9916736	1481419	298239	-118744
1989	8000000	320000	800000	0	31907	9015	7.4	0	15.7	667	1152574	5389035	10321268	1618942	466368	144508
1990	7680000	320000	768000	0	33502	8313	7.8	0	16.5	646	1122149	5964875	10725800	1766515	644367	475170
1991	7360000	320000	736000	0	35178	10380	8.2	0	17.3	847	1092025	6474313	11130332	1924798	832773	863665
1992	7040000	320000	704000	0	36936	12466	8.6	0	18.2	1068	1062005	6924706	11534864	2094492	1032488	1301541
1993	6720000	320000	672000	0	38783	14572	9.0	68344	19.1	14341	1045125	7327647	11939396	2276344	1231220	1776229
1994	6400000	320000	640000	0	40722	35717	9.4	194086	20.0	42229	1042951	7693195	12343928	2471145	1428194	2276802
1995	6080000	320000	608000	0	42758	58069	9.9	398563	21.0	89539	1060297	8031038	12748460	2679735	1619438	2792805
1996	5760000	320000	576000	0	44896	28769	10.4	678362	22.1	152718	1093615	8347820	13152993	2903007	1809392	3316922
1997	5440000	320000	544000	0	47141	6739	10.9	984550	23.2	228903	1140044	8648029	13557525	3141906	2001862	3844075
1998	5120000	320000	512000	0	49498	0	11.5	1318554	24.3	320848	1202347	8935861	13962057	3397437	2195091	4369562
1999	4800000	320000	480000	0	51973	0	12.1	1660747	25.6	424321	1276295	9213620	14366589	3670667	2394373	4890647
2000	4480000	320000	448000	0	54572	0	12.7	2052688	26.8	550686	1373257	9485312	14771121	3962727	2589469	5402960
2001	4160000	320000	416000	0	57300	0	13.3	2454238	28.2	691332	1484633	9752336	15175653	4274815	2790183	5904799
2002	3840000	320000	384000	0	60165	0	14.0	2855788	29.6	844667	1608832	10015393	15580185	4608206	2999374	6395220
2003	3520000	320000	352000	0	63174	0	14.7	3257338	31.1	1011606	1746780	10275040	15984717	4964249	3217469	6873477
2004	3200000	320000	320000	0	66332	0	15.4	3658888	32.6	1193128	1899460	10531716	16389249	5344375	3444915	7338990
2005	2880000	320000	288000	0	69649	0	16.2	4060438	34.2	1390273	2067922	10785752	16793782	5750104	3682182	7791331
2006	2560000	320000	256000	0	73132	0	17.0	4461988	36.0	1604150	2253281	11037394	17198314	6183044	3929763	8230200
2007	2240000	320000	224000	0	76788	0	17.8	4863538	37.7	1835938	2456726	11286814	17602846	6644903	4188177	8655407
2008	1920000	320000	192000	0	80627	0	18.7	5265088	39.6	2086896	2679523	11534124	18007378	7137490	4457967	9066859
2009	1600000	320000	160000	0	84659	0	19.6	5666638	41.6	2358359	2923017	11779381	18411910	7662724	4739707	9464547
2010	1280000	320000	128000	0	88892	0	20.6	6068188	43.7	2651751	3188643	12022603	18816442	8222638	5033995	9848528
2011	960000	320000	96000	0	93336	0	21.7	6469738	45.9	2968586	3477923	12263774	19220974	8819386	5341464	10218923
2012	640000	320000	64000	0	98003	0	22.7	6871288	48.2	3310476	3792479	12502849	19625506	9455252	5662773	10575901
2013	320000	320000	32000	0	102903	0	23.9	7272838	50.6	3679133	4134036	12739765	20030039	10132657	5998621	10919673

APPENDIX C

FLOW-DURATION CURVES

APPENDIX C

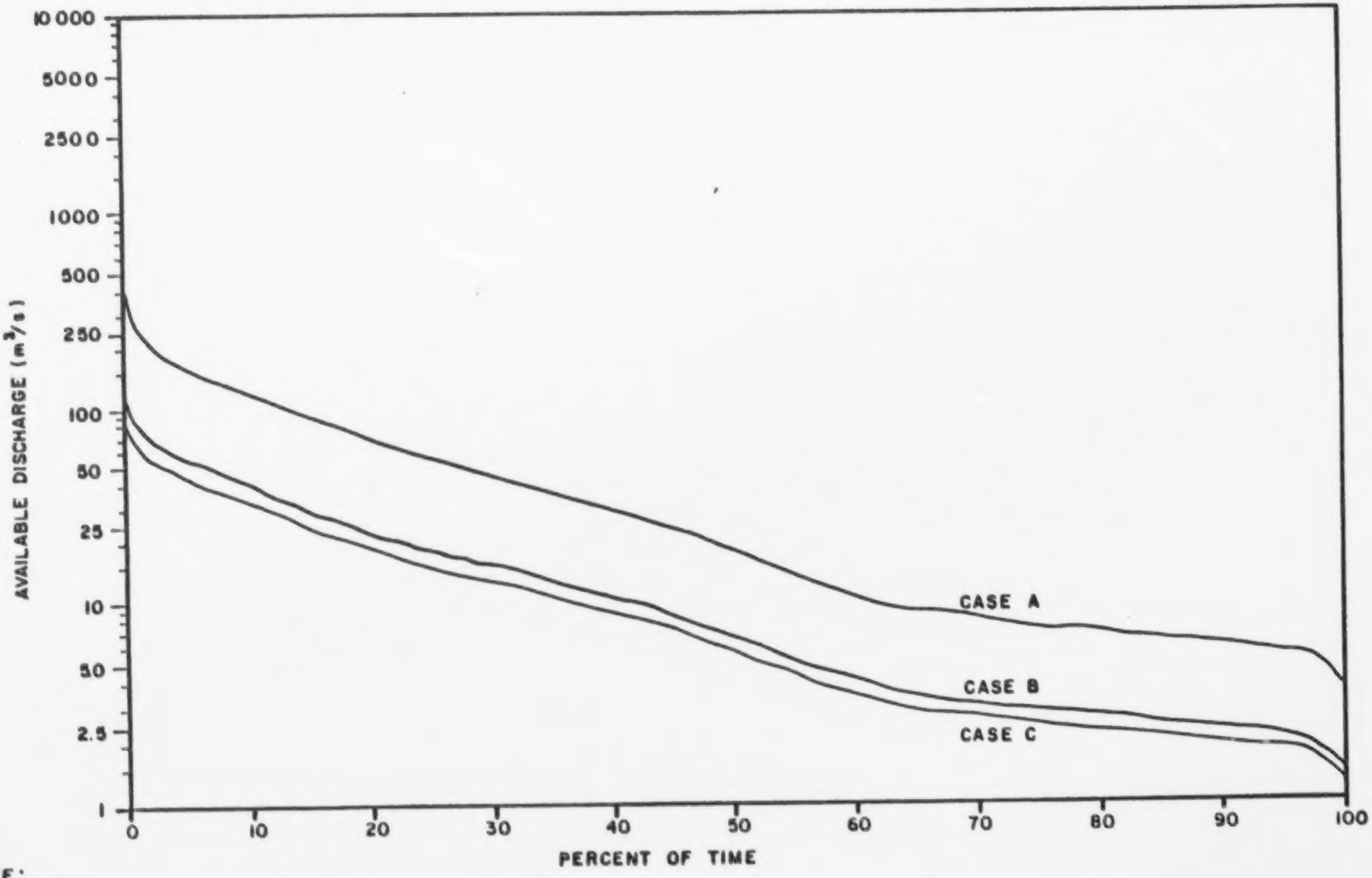
Flow Duration Curves

The plots presented in Figures C-1 to C-13 summarize the annual and monthly total water flows available at the powerhouse. These flow values represent the full magnitude of the water resource calculated according to the methods described in Section 4.2 recognizing no restrictions on canal capacity or power flow.

The power flows which correspond to the installed capacities considered in this study are:

Installed Capacity (kW)	Power Flow (m^3/s)
1000	1.85
2000	3.69

The flow duration curves illustrate the very small effect that power diversion would have on the flows in natural channels of the Klondike River during most of the year. The opportunity to increase energy output by installing additional generating capacity beyond the values considered in this report can be evaluated using these data.



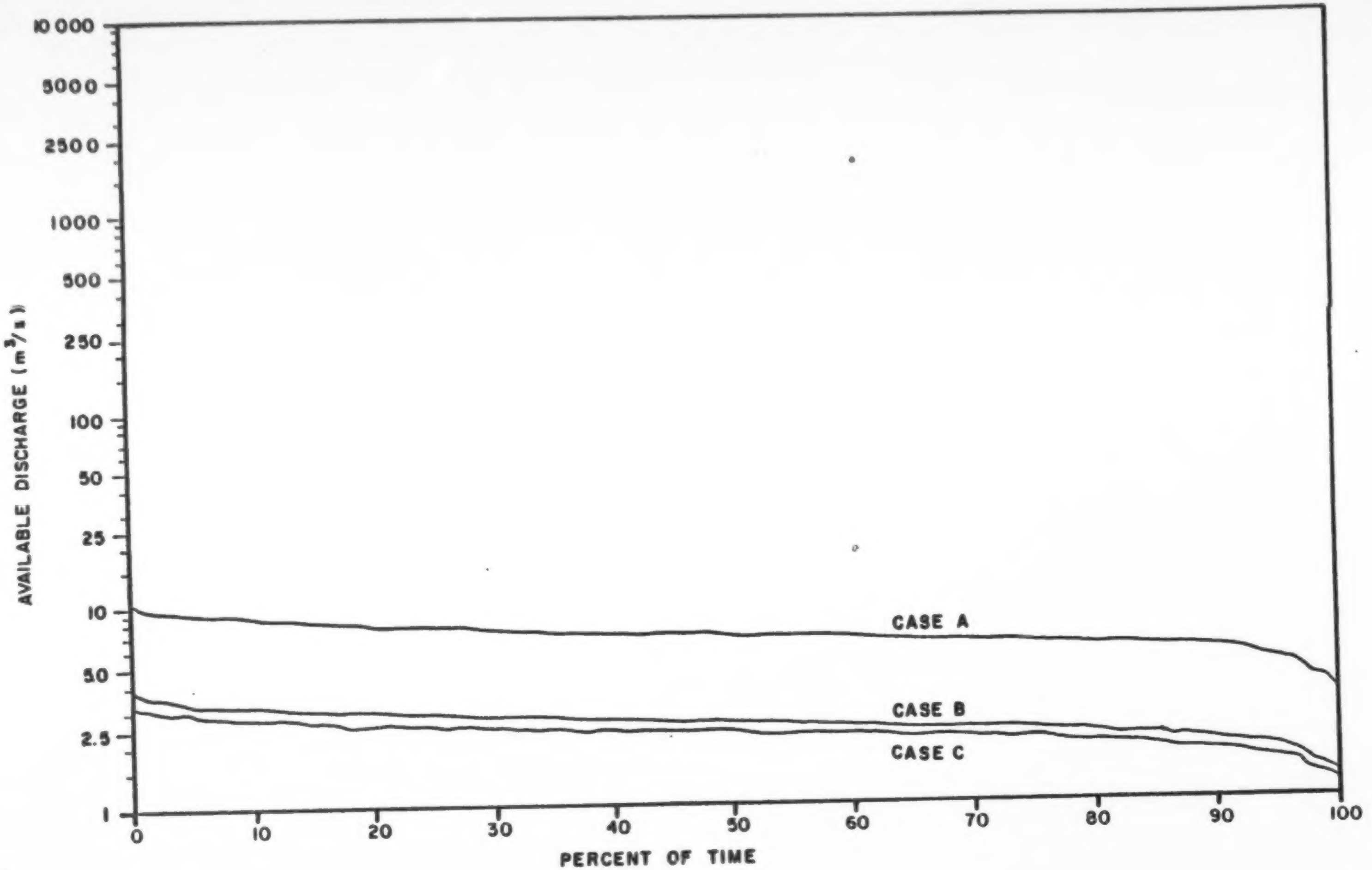
NOTE:

CASE A – KLONDIKE AND NORTH KLONDIKE
CASE B – NORTH KLONDIKE AND LOCAL SOUTH CHANNEL INFLOW
CASE C – NORTH KLONDIKE ONLY

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
DURATION CURVE OF AVAILABLE DISCHARGE FOR YEAR

FIG. C.1

ACRES



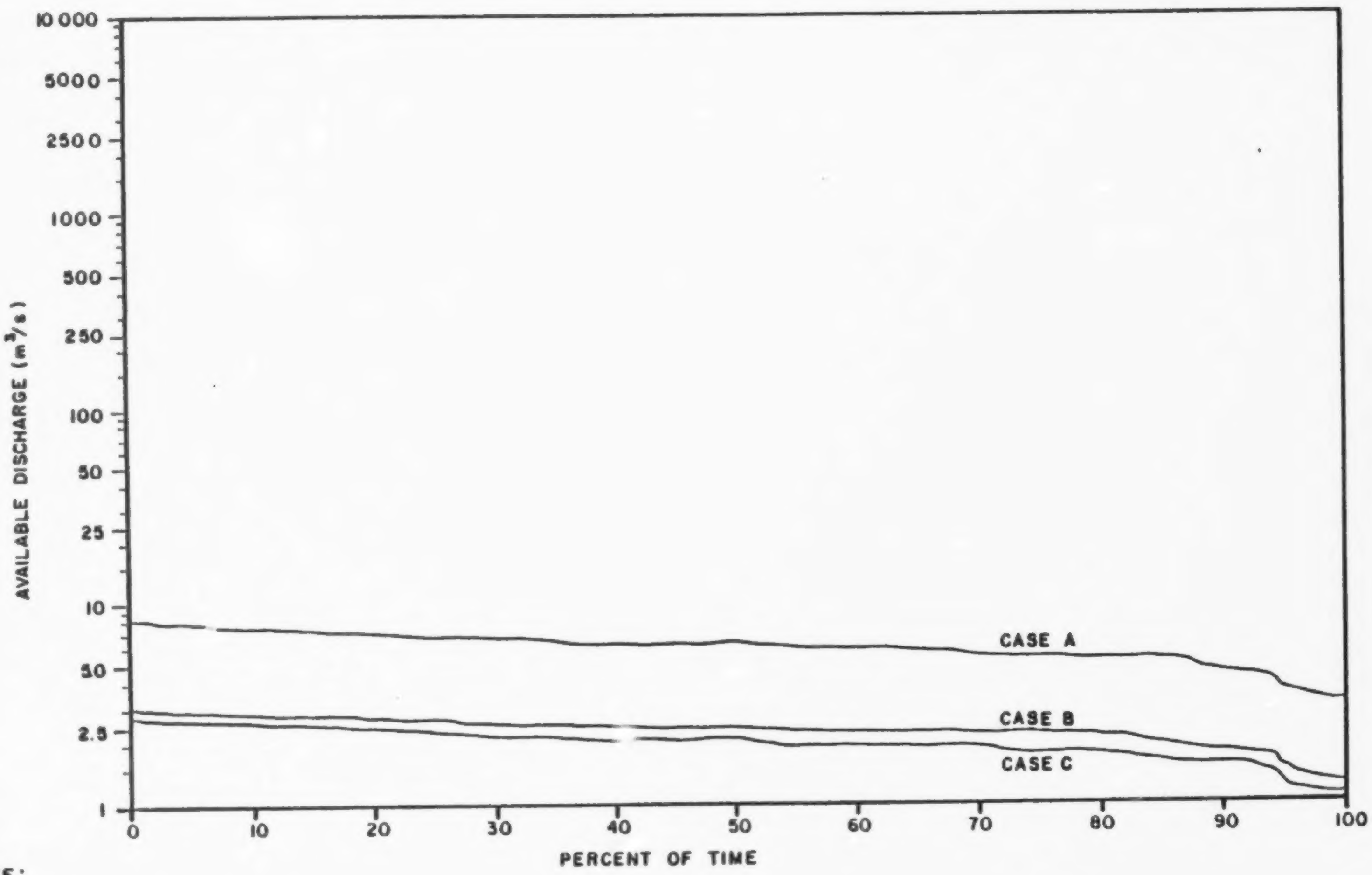
NOTE:

CASE A – KLONDIKE AND NORTH KLONDIKE
CASE B – NORTH KLONDIKE AND LOCAL SOUTH CHANNEL INFLOW
CASE C – NORTH KLONDIKE ONLY

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
DURATION CURVE OF AVAILABLE DISCHARGE FOR JANUARY

FIG. C.2

ACRES



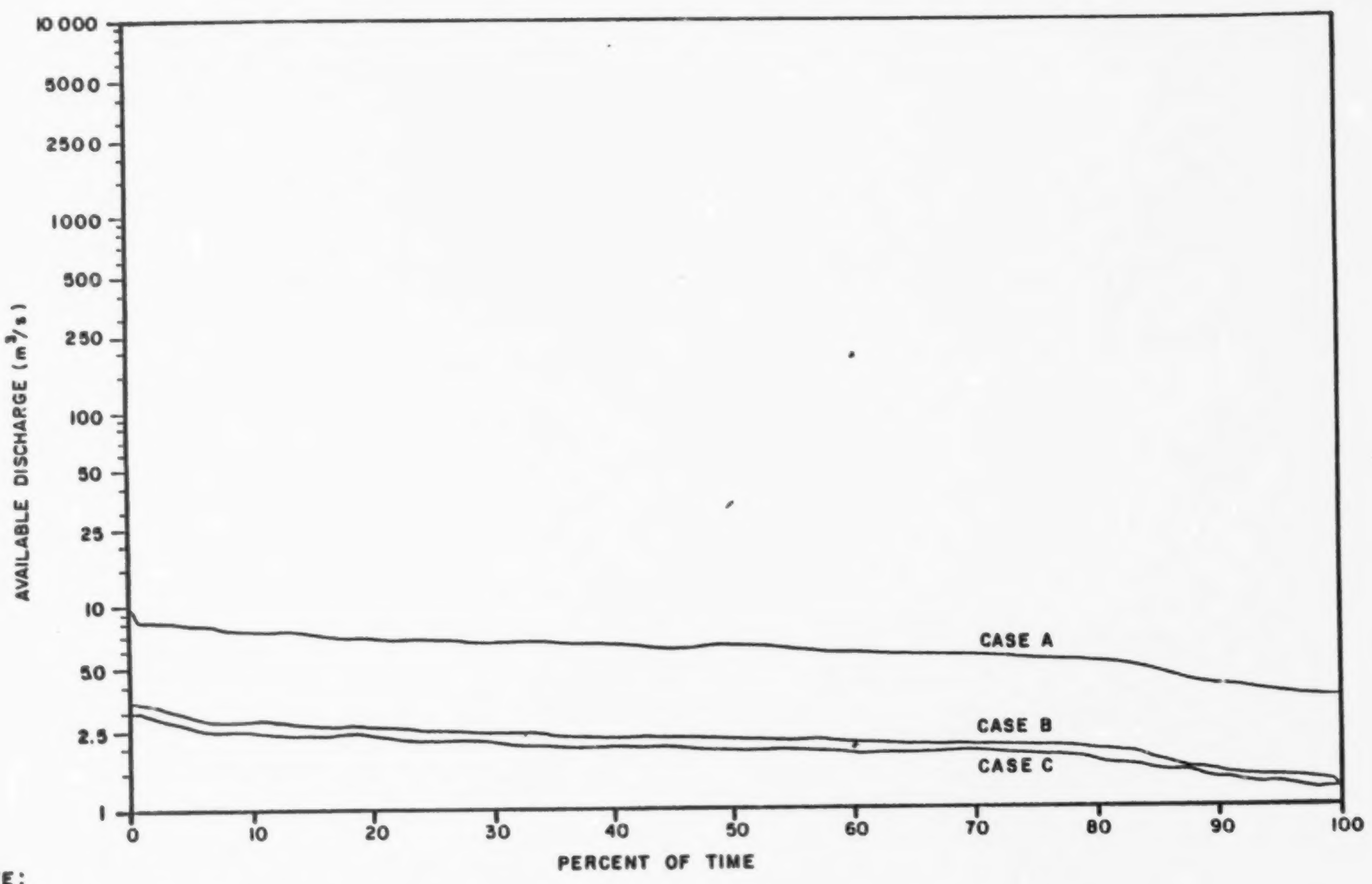
NOTE:

CASE A – KLONDIKE AND NORTH KLONDIKE
CASE B – NORTH KLONDIKE AND LOCAL SOUTH CHANNEL INFLOW
CASE C – NORTH KLONDIKE ONLY

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
DURATION CURVE OF AVAILABLE DISCHARGE FOR FEBRUARY

FIG. C.3

ACRES



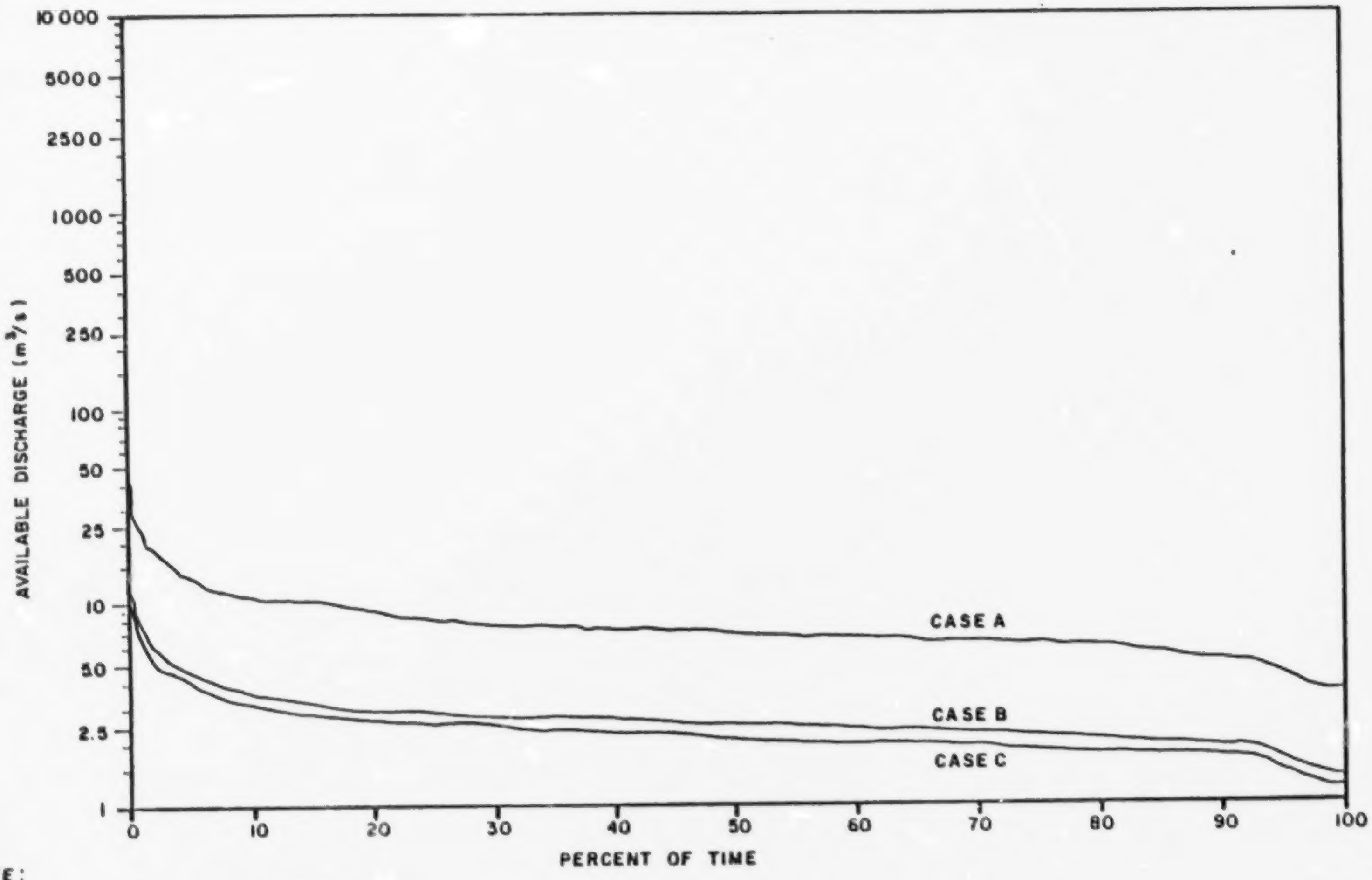
NOTE:

CASE A – KLONDIKE AND NORTH KLONDIKE
CASE B – NORTH KLONDIKE AND LOCAL SOUTH CHANNEL INFLOW
CASE C – NORTH KLONDIKE ONLY

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
DURATION CURVE OF AVAILABLE DISCHARGE FOR MARCH

FIG. C.4

ACRES



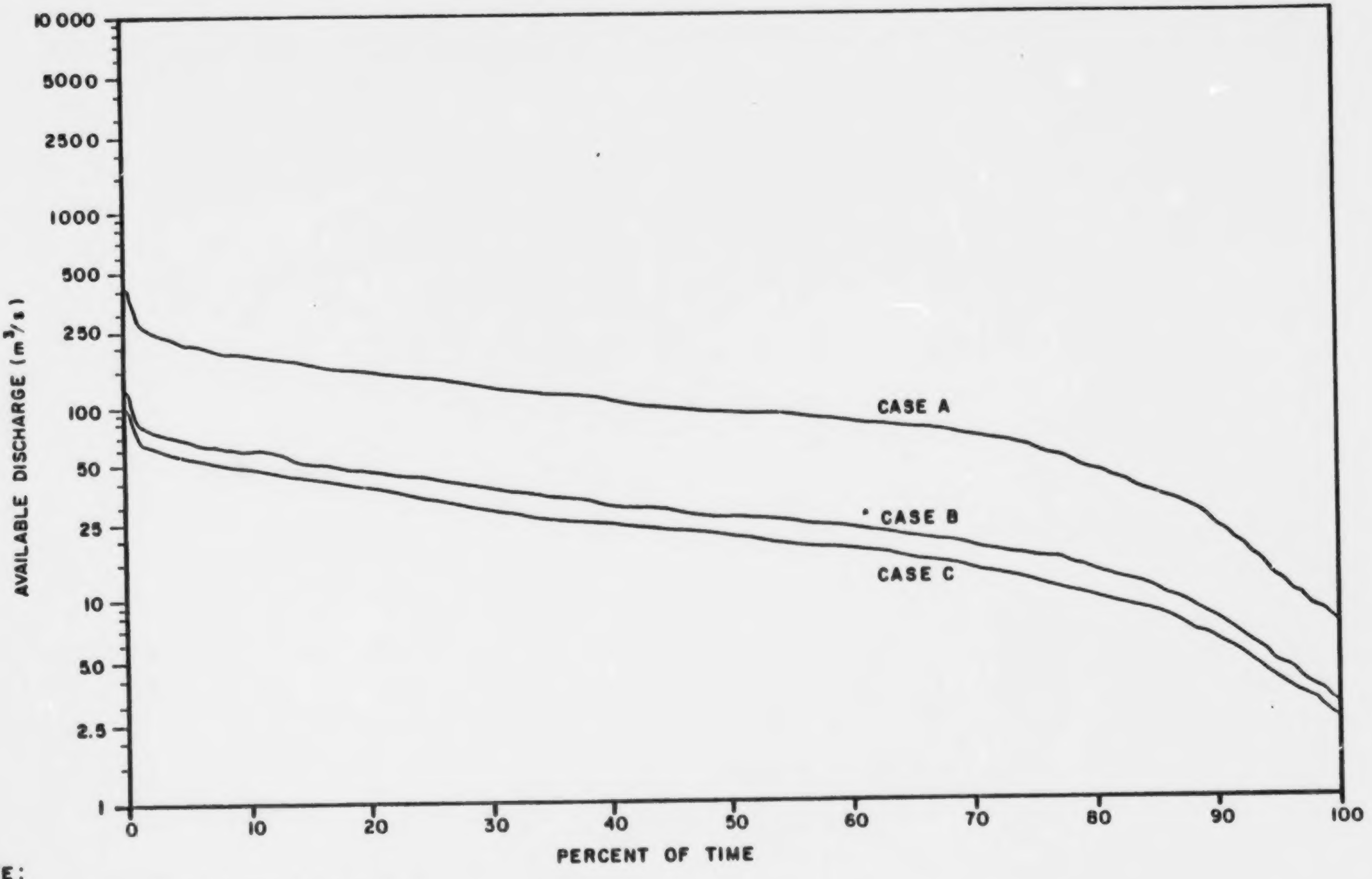
NOTE:

CASE A – KLONDIKE AND NORTH KLONDIKE
CASE B – NORTH KLONDIKE AND LOCAL SOUTH CHANNEL INFLOW
CASE C – NORTH KLONDIKE ONLY

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
DURATION CURVE OF AVAILABLE DISCHARGE FOR APRIL

FIG. C.5

ACRES



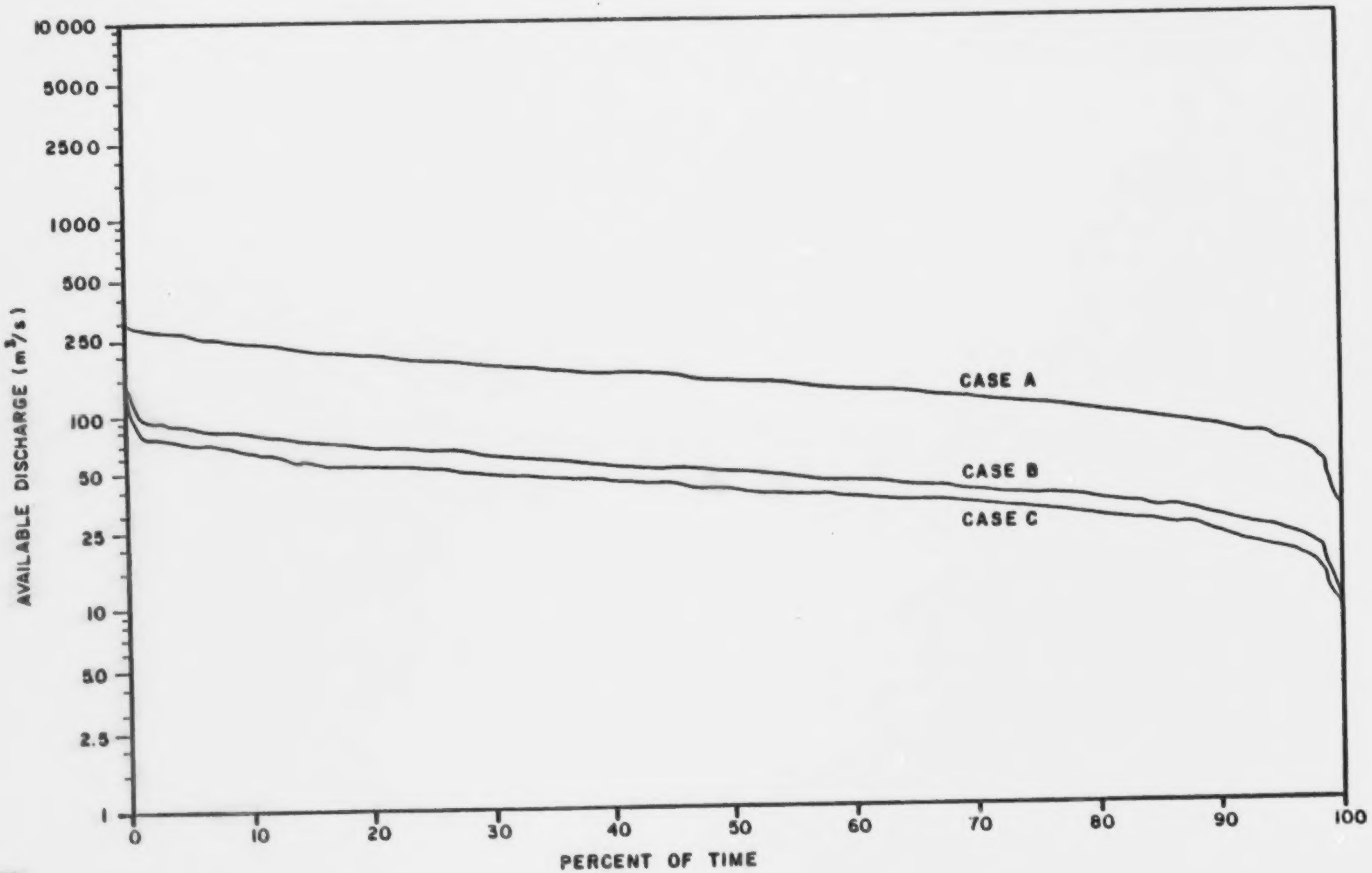
NOTE:

CASE A – KLONDIKE AND NORTH KLONDIKE
CASE B – NORTH KLONDIKE AND LOCAL SOUTH CHANNEL INFLOW
CASE C – NORTH KLONDIKE ONLY

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
DURATION CURVE OF AVAILABLE DISCHARGE FOR MAY

FIG. C.6

ACRES



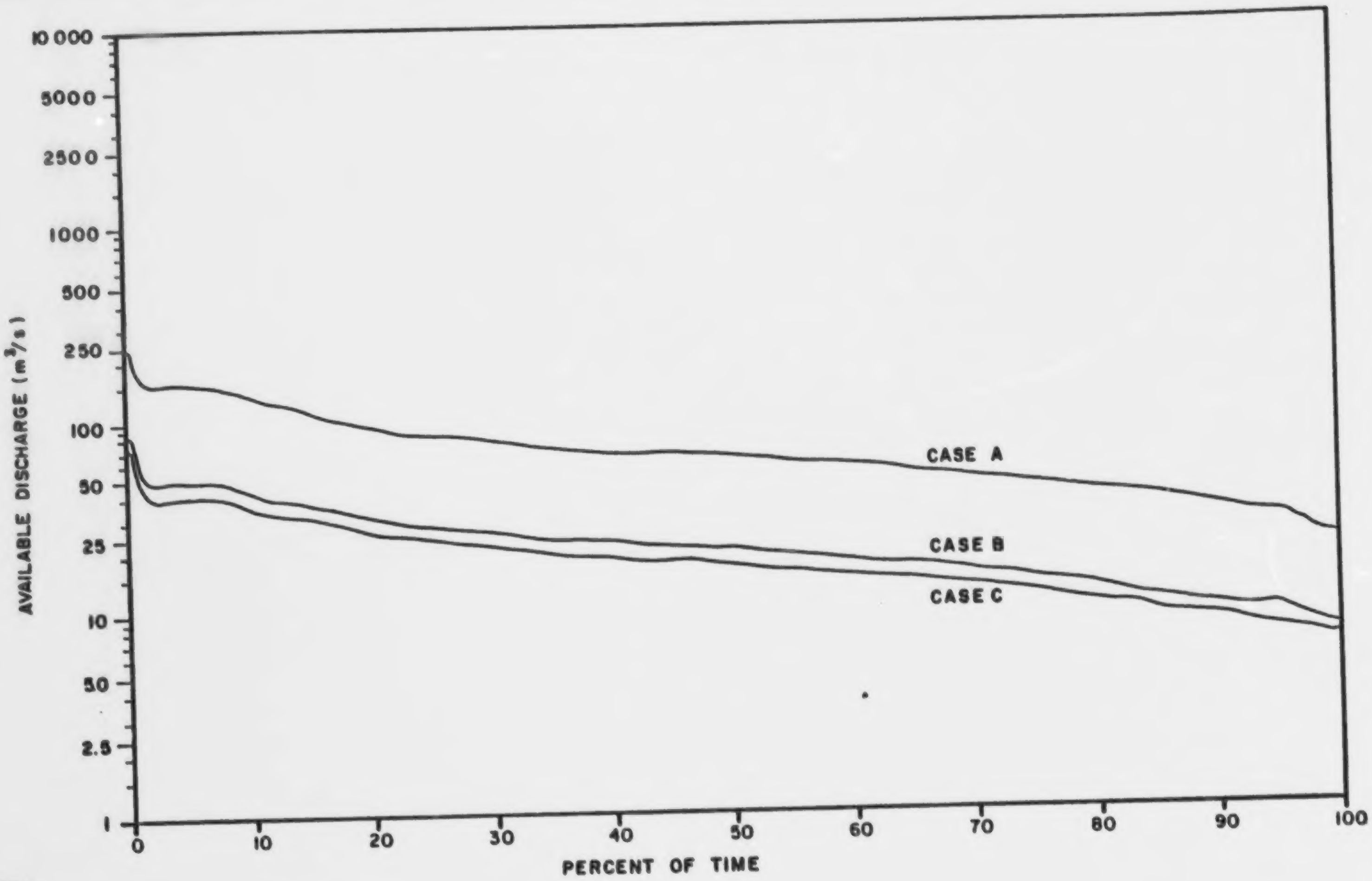
NOTE:

CASE A – KLONDIKE AND NORTH KLONDIKE
CASE B – NORTH KLONDIKE AND LOCAL SOUTH CHANNEL INFLOW
CASE C – NORTH KLONDIKE ONLY

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
DURATION CURVE OF AVAILABLE DISCHARGE FOR JUNE

FIG. C.7

ACRES



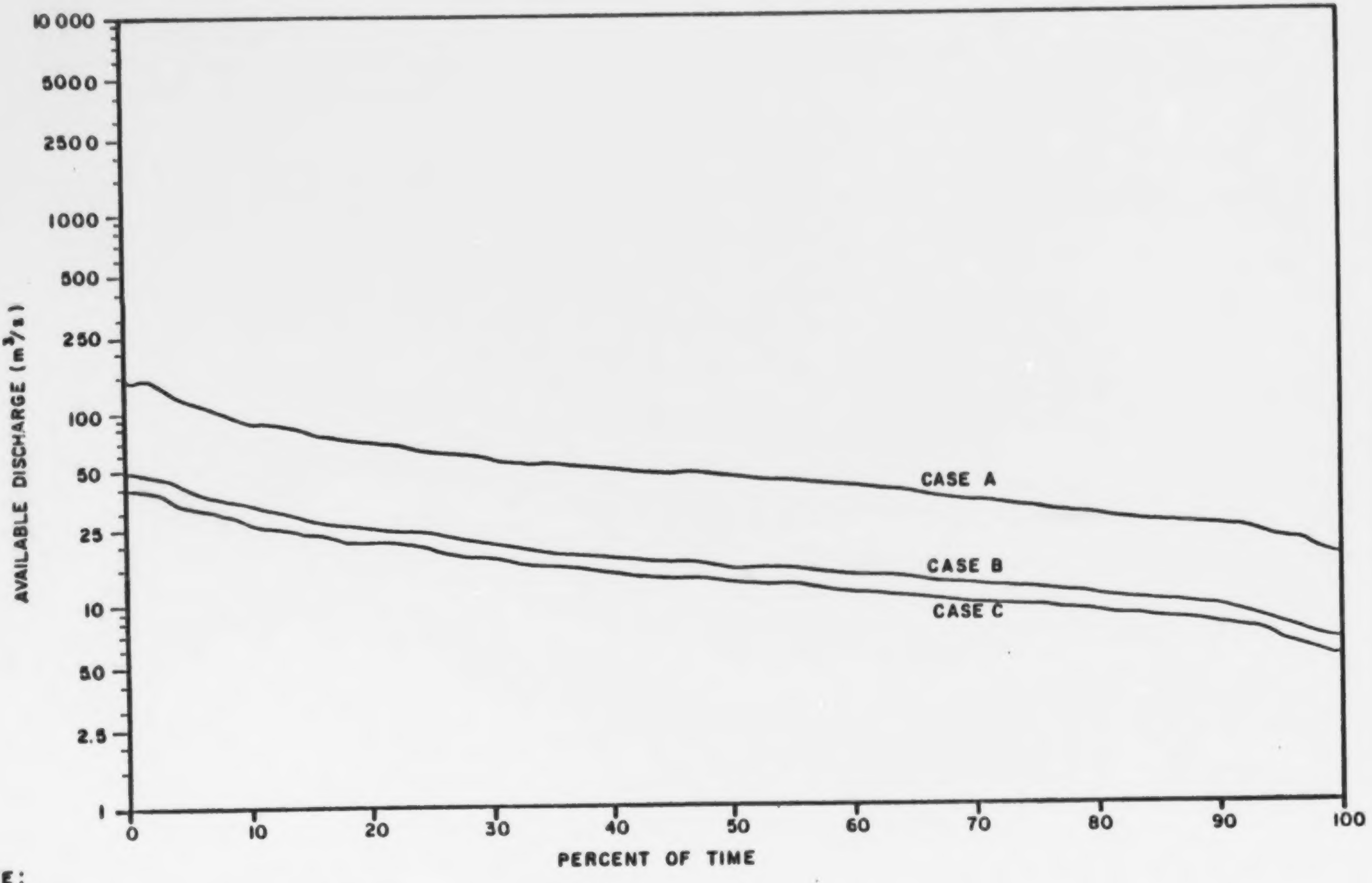
NOTE:

CASE A – KLONDIKE AND NORTH KLONDIKE
CASE B – NORTH KLONDIKE AND LOCAL SOUTH CHANNEL INFLOW
CASE C – NORTH KLONDIKE ONLY

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
DURATION CURVE OF AVAILABLE DISCHARGE FOR JULY

FIG. C.8

ACRES



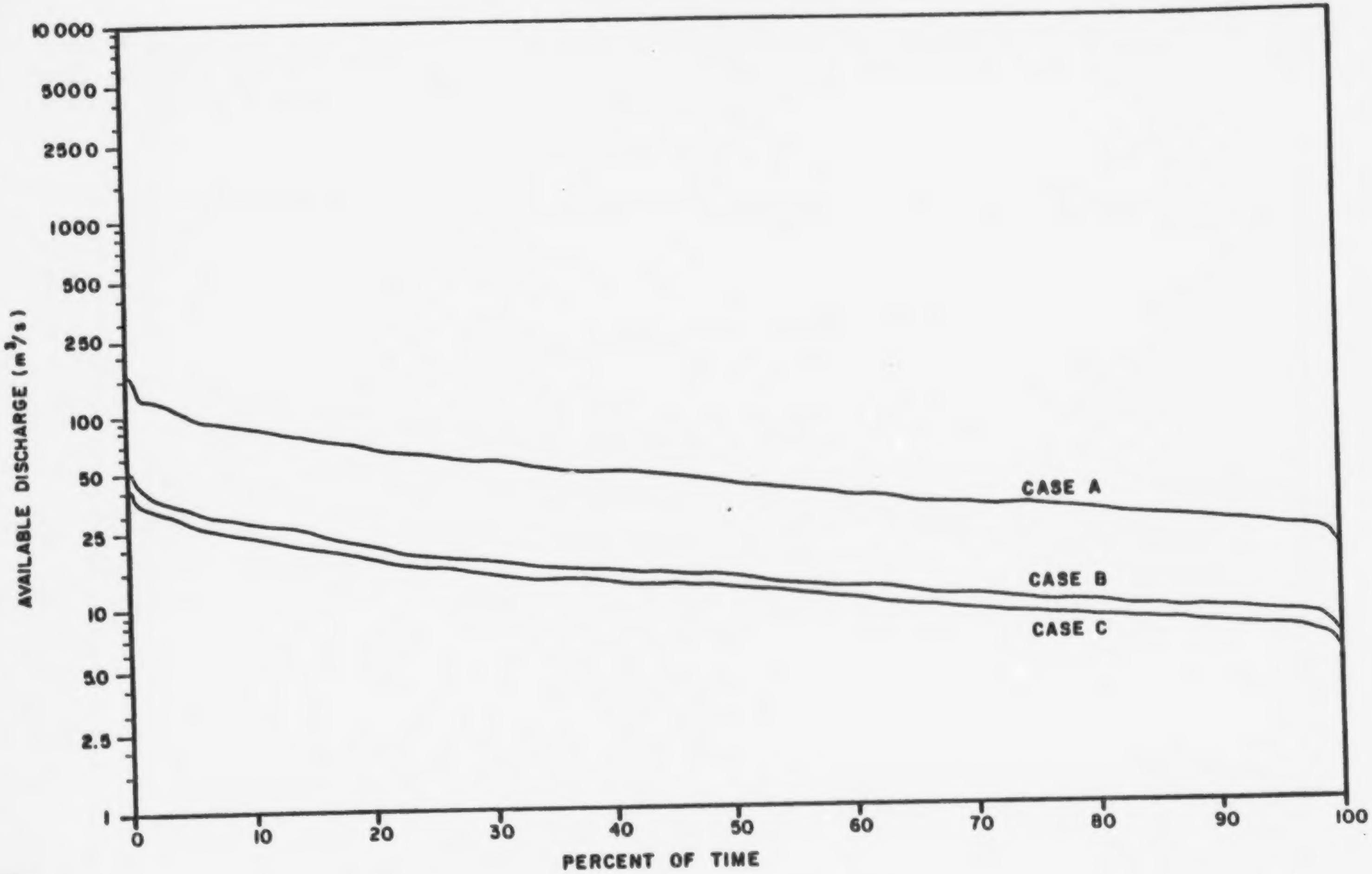
NOTE:

CASE A - KLONDIKE AND NORTH KLONDIKE
CASE B - NORTH KLONDIKE AND LOCAL SOUTH CHANNEL INFLOW
CASE C - NORTH KLONDIKE ONLY

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
DURATION CURVE OF AVAILABLE DISCHARGE FOR AUGUST

FIG. C.9

ACRES



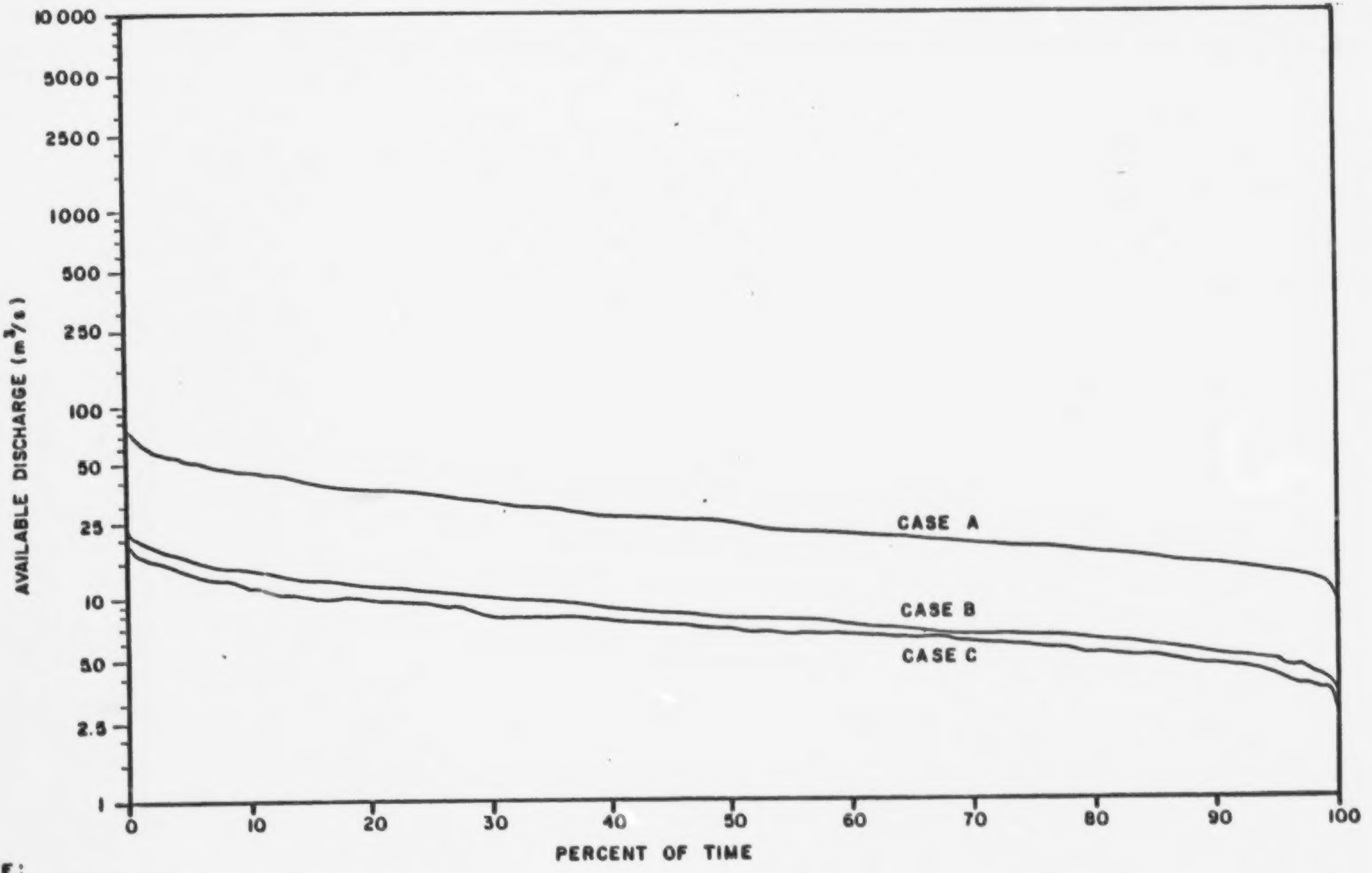
NOTE:

CASE A – KLONDIKE AND NORTH KLONDIKE
CASE B – NORTH KLONDIKE AND LOCAL SOUTH CHANNEL INFLOW
CASE C – NORTH KLONDIKE ONLY

FIG. C.10

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
DURATION CURVE OF AVAILABLE DISCHARGE FOR SEPTEMBER

ACRES



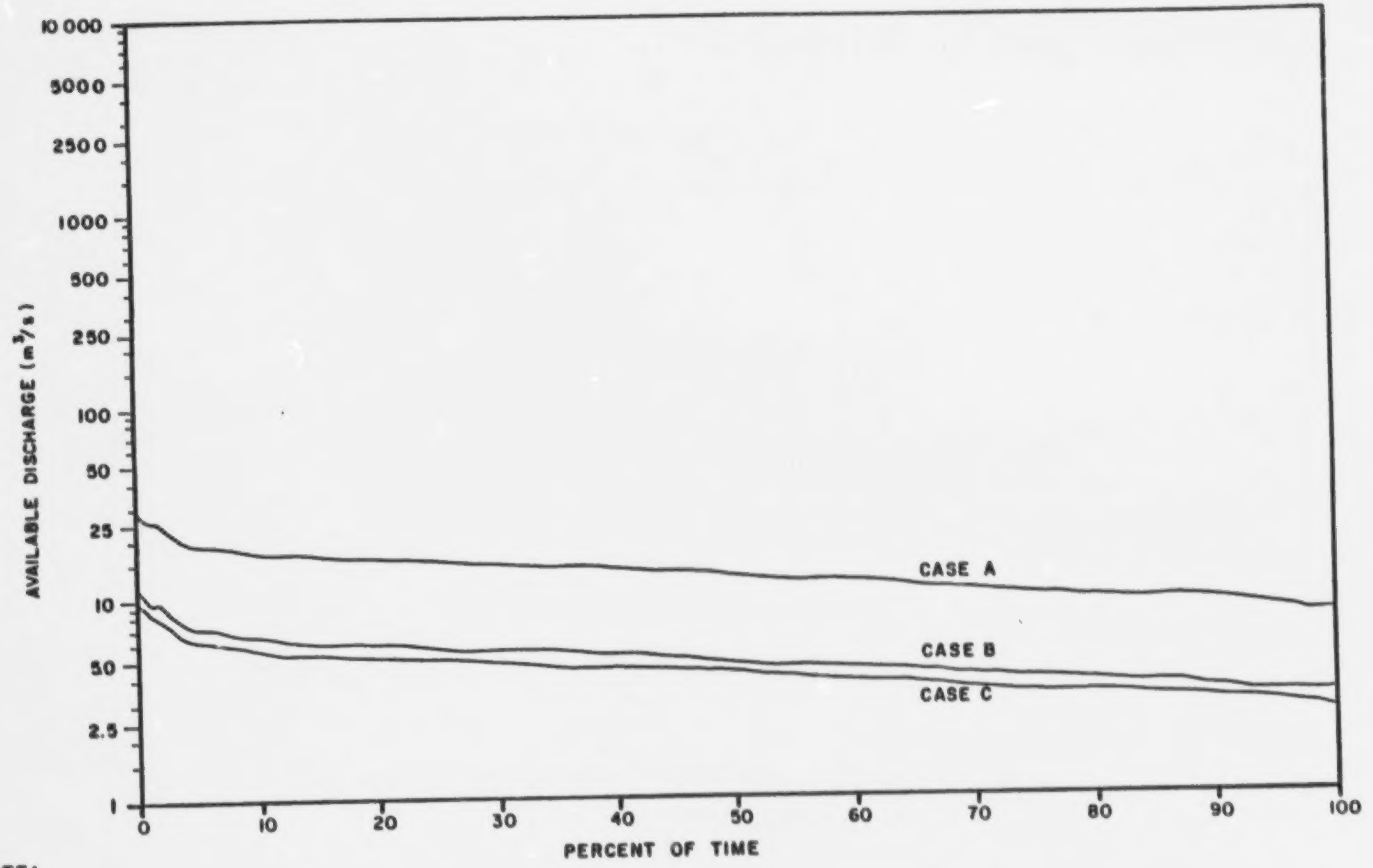
NOTE:

CASE A – KLONDIKE AND NORTH KLONDIKE
CASE B – NORTH KLONDIKE AND LOCAL SOUTH CHANNEL INFLOW
CASE C – NORTH KLONDIKE ONLY

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
DURATION CURVE OF AVAILABLE DISCHARGE FOR OCTOBER

FIG. C.11

ACRES



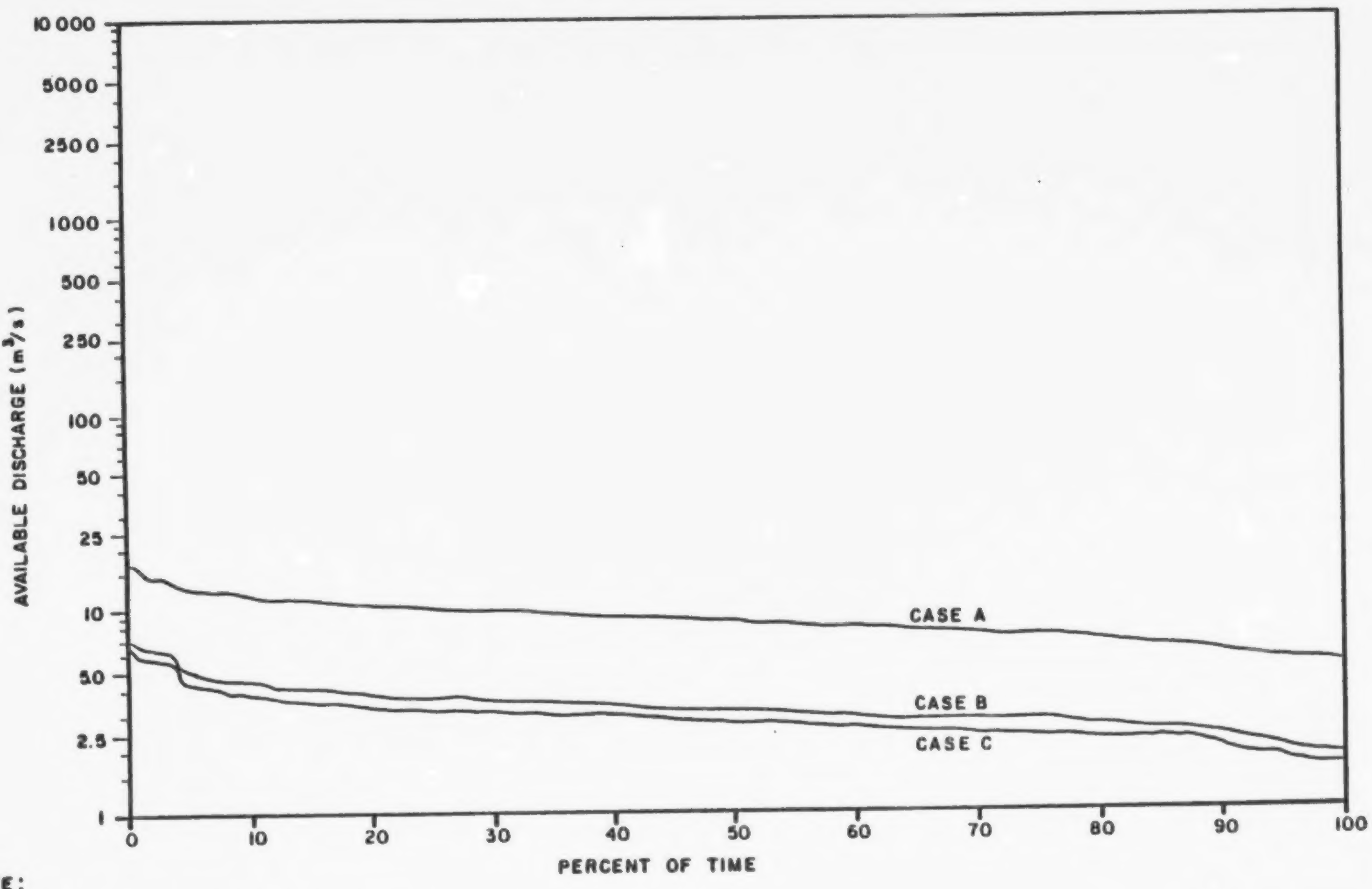
NOTE:

CASE A – KLONDIKE AND NORTH KLONDIKE
CASE B – NORTH KLONDIKE AND LOCAL SOUTH CHANNEL INFLOW
CASE C – NORTH KLONDIKE ONLY

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
DURATION CURVE OF AVAILABLE DISCHARGE FOR NOVEMBER

FIG. C.12

ACRES



NOTE:

CASE A – KLONDIKE AND NORTH KLONDIKE
CASE B – NORTH KLONDIKE AND LOCAL SOUTH CHANNEL INFLOW
CASE C – NORTH KLONDIKE ONLY

FIG.C.13

KLONDIKE NORTH FORK HYDROELECTRIC
POWER GENERATION STUDY
DURATION CURVE OF AVAILABLE DISCHARGE FOR DECEMBER

ACRES

APPENDIX D

REFERENCE DATA

APPENDIX D

REFERENCE DATA

The following reference data were collected and used in preparing this study.

REPORTS

MECo report "Dawson City Utilities, Interim Report", October 1961.

NCPC Memo 1241, Heale to MacIntyre dated 18 August 1975, "Dawson North Fork Hydro Canal Reconnaissance".

Monenco letter report to NCPC dated 19 October 1976, "Dawson City Hydro".

NCPC draft of "Dawson Feasibility Report", December 1976.

Energy Exploration Ltd. (EEL) Water Licence Application Submission "Klondike Hydropower Reactivation" November 4, 1982.

Yukon Territory Water Board, "Reasons for Decision" for refusing EEL Water Licence. December 1, 1983.

Extract from NCPC "Forecast of Electrical Energy Requirements in the Yukon Territory and Northwest Territories 1982/83 - 2002/03", August 1983.

Geological Survey of Canada Memo 234 "Mining Industry of Yukon 1939 and 1940" by H.S. Bostok.

DRAWINGS

Northern Canada Power Commission Drawings

South Fork canal profile, Fig. 6.1
North Fork canal profile, Fig. 6.2
South Fork canal profile
Cross sections of South Fork canal (2 sheets)
North Fork canal profile (1 sheet)
Klondike River Drainage Basin Plan, Fig. 5.1

Yukon Consolidated Gold Corporation Drawings North Fork Development

Drawing #	Title
A-1	North Fork Power Plant Extension. Details of Penstock
A-2	North Fork Power Plant Extension. General Arrangement
A-5	North Fork Power Plant Extension. General Floor and Foundation Arrangement
A-9	South Fork Ditch. Detail of Spillways
1119	North Fork Camp. Fire Insurance Plan
8124	North Fork Spillway. Plan and Details
8211	North Fork Ditch. Spillway Topography
8218	North Fork Powerplant. Detail of Tailrace
8224	North Fork Ditch. Detail of Spillway. Flume Extension
8523	North Fork Intake. Dam and Apron. 1941 Repairs
8647	North Fork Power Plant. Expansion Joint No. 2 Penstock
8720	South Fork Ditch. Plan and Details of Lee Creek. Dam and Spillway
8794	South Fork Ditch. North Fork Point Spillway
8795	South Fork Ditch. North Point Spillway
8883	North Fork. Gate For No. 3 Penstock
9231	South Fork Ditch. Plan and Details of Gatehouse
No #	North Fork Intake. Detail of Gatehouse
No #	Plan and Cross-Sections. Canadian Klondike Power Co. Ditch From Spillway to Pressure Box
No #	Plan Ditch and Pipeline. North Fork Klondike River. Proposed Water and Power System
No #	Plan and Cross-Sections. North Fork Intake
No #	Plan North Fork Ditch Spillway

Mischenko Report

Plan of Recce, Proposed Reservoir Site

Map of Areas Between Big Lake and Camp Petrograd

Map of Intake of New Ditch and Proposed Dam Across North Fork River

Public Archives, Canada

The following drawings, surveys and plans produced by YCC during the life of the power project, were obtained from Public Archives, Canada in Ottawa, Whitehorse and Dawson. The list was selected from the considerable volume of data and information acquired by Public Archives Canada after the dissolution of YCGC. Permission to use the data was first obtained from Teck Corporation, Vancouver, who are the current owners of the YCGC records in the Public Archives.

Microfiche #	Title
51779	Plan Ditch and Pipeline. North Fork Klondike River. Proposed Water and Power System
51786	North Fork Spillway. Diversion Profile
51787	Profile of Penstock
51788	Plan. South Fork Ditch
51789	Profile of Penstocks No's 1 & 2. Sheets 1-3
51790	Canal Profile. Sheets 1 & 2.
51791	Profile North Fork Diversion Channel. Sheets 1 & 2
51792	Profile Penstock No. 3 Excavation. Sheets 1 & 2
51793	Plan North Fork Intake
51794	Sketch Plan North and South Forks
51795	North Fork Cross-Sections

Microfiche #	Title (Public Archives Contd)
51796	Plan South Fork. Sheets 1 & 2
51797	North Fork Ditch Profile. Sheets 1-3
51798	South Fork Ditch Profile. Sheets 1-5
51799	South Fork Canal Profile. Sheets 1-5
51800	Cross-Sections. Sheets 1-5
51801	North Fork Canal. Sheets 1-4
51803	General Arrangement Section Elevation. 5000 H.P. Morris Turbine
51804	Details of Voids in Concrete. For 5000 H.P. Morris Turbine
51805	General Arrangment of Relief Valve
51957	Plan. Proposed Location of Pipe on Lake Bottom For North Powerhouse
51958	General Arrangement Plan of 5000 H.P. Morris Turbine

Mischenko Report

Microfiche #	Title
51778	Map of Area Between. Big Lake and Camp Petrograd
51780	Plan of Intake Bridge. Lower Klondike Ditch
51781	Sketch Plan. North Fork Valley. Possible Reservoir Sites
51782	Map Intake New Ditch and Proposed Dam Across North Fork River
51783	Proposed Reservoir Site
51784	Sketch Plan. North Fork Valley. Possible Reservoir Sites
51785	Plan of Locus of Reservoir

Parks Canada

Power graphs produced by YCGC operators for the periods December 1940 to June 1949 and October 1965 to November 1966 were obtained from Parks Canada, Dawson. These show hourly plant output in kilowatts.

National Airphoto Library

The following aerial photographs cover all or part of the project site

Airphoto No.

A17155 - 81-85
A17059 - 155-160
A12267 - 186
A13230 - 232-235
A13135 - 2-6, 71-76
A12068 - 224-227

Detailed Computational Results Supporting this Study

Hydrology

ACRES File Number P7252.00.302

Power and Energy Analyses

YECL File Number